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OF MICHIGAN

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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# INTRODUCTION

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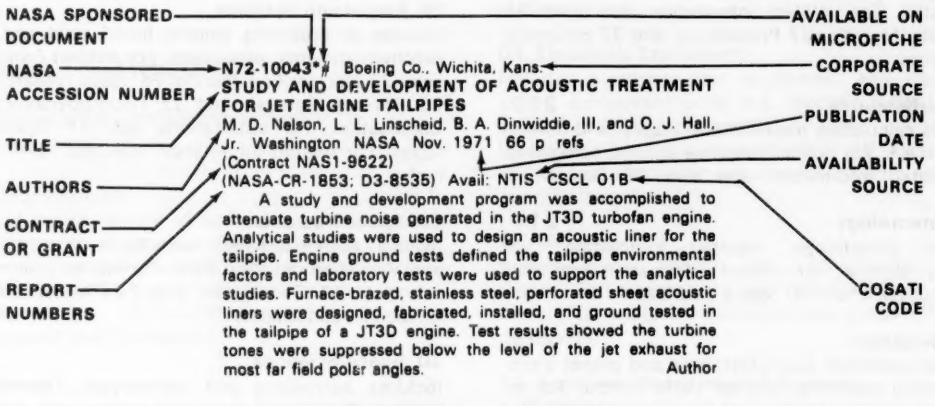
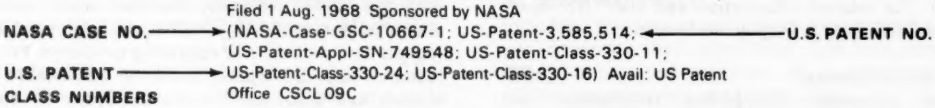



N72-10043*# Boeing Co., Wichita, Kans.
**STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES**
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B

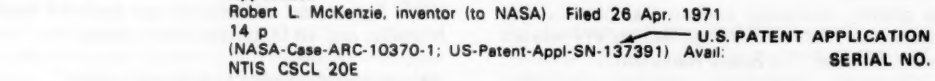
A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

## PATENT CITATION




N71-33129* Collins Radio Co., Cedar Rapids, Iowa.
**POWER RESPONSIVE OVERLOAD SENSING CIRCUIT Patent**
Arthur P. Kubicz, inventor (to NASA) Issued 15 Jun. 1971 8 p
Filed 1 Aug. 1968 Sponsored by NASA
(NASA-Case-GSC-10667-1; US-Patent-3,585,514; US-Patent-Appl-SN-749548; US-Patent-Class-330-11; US-Patent-Class-330-24; US-Patent-Class-330-16) Avail: US Patent Office CSCL 09C

## PATENT APPLICATION CITATION




N72-10432*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**DIATOMIC INFRARED GASDYNAMIC LASER Patent Application**
Robert L. McKenzie, inventor (to NASA) Filed 26 Apr. 1971 14 p
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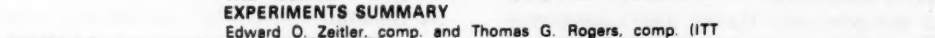


N72-10856*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY**
Edward O. Zeitler, comp. and Thomas G. Rogers, comp. (ITT Federal Electric Corp. Houston, Tex.) Sep. 1971 554 p refs
(NASA-TM-X-58075) Avail: NTIS HC $6.00/MF $0.95
CSCL 22C

Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

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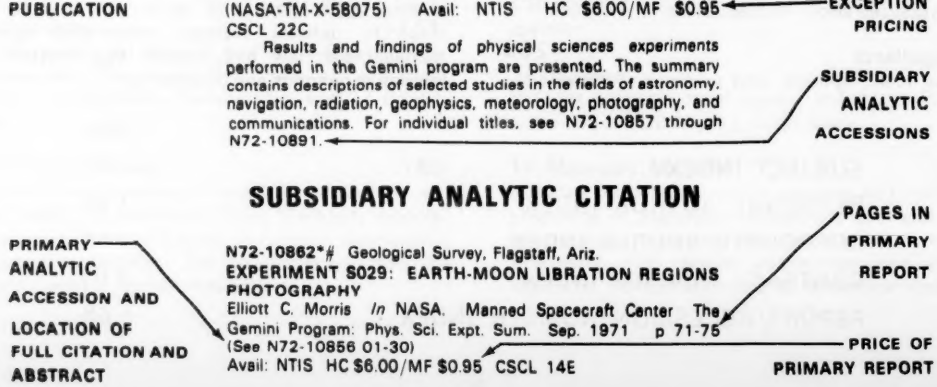
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N72-10862*# Geological Survey, Flagstaff, Ariz.
**EXPERIMENT S029: EARTH-MOON LIBRATION REGIONS PHOTOGRAPHY**
Elliott C. Morris *In* NASA. Manned Spacecraft Center The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 71-75
(See N72-10856 01-30)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

VOLUME 10 NUMBER 2 / JANUARY 23, 1972

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**N72-10998#** National Aerospace Lab., Amsterdam (Netherlands).
**COMPARISON BETWEEN DISCRETE AND CONTINUOUS MODELS FOR VERTICAL GUSTS**
J. B. DeJonge Feb. 1971 68 p
(NLR-TR-71025U) Avail: NTIS

A number of currently existing gust load models, based either on a discrete gust concept or a continuous gust concept, have been analyzed and compared. Calculations made for three different aircraft types indicated that load spectra based on either of the two model-types show relatively small differences. How flexibility effects may be accounted for in conjunction with a discrete gust model, using a technique based on the continuous gust concept, is described. Author

**N72-10999#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**SOME RESULTS ON GUST ALLEVIATION**
Gabriel Coupry 1971 12 p refs Presented at the R. Ae. S. Intern. Conf. on Atmospheric Turbulence, London, 18-21 May 1971
(ONERA-TP-925) Avail: NTIS

The mathematical search for a linear functional law which defines longitudinal response of delta wing aircraft to turbulence is discussed. Turbulence is measured in real time, aboard the aircraft with the help of information given by vanes, gyrometers, and accelerometers. The results indicate that with the help of the Wiener and Leguerre methods, gust alleviation can be provided without change to the flight mechanics of the aircraft. An analog computer analysis of the method and flight test results is also given. Author

**N72-11000*#** Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**ON THE TRANSONIC AERODYNAMICS OF A COMPRESSOR BLADE ROW Final Report, Aug. 1970 - Sep. 1971**
J. C. Erickson, Jr., J. A. Lordi, and W. J. Rae Oct. 1971 46 p refs
(Contract NASw-2091)
(NASA-CR-123320; CAL-AI-3003-A-1) Avail: NTIS CSCL 20D

Linearized analyses have been carried out for the induced velocity and pressure fields within a compressor blade row operating in an infinite annulus at transonic Mach numbers of the flow relative to the blades. In addition, the relationship between the induced velocity and the shape of the mean blade surface has been determined. A computational scheme has been developed for evaluating the blade mean surface ordinates and surface pressure distributions. The separation of the effects of a specified blade thickness distribution from the effects of a specified distribution of the blade lift has been established. In this way, blade mean surface shapes that are necessary for the blades to be locally nonlifting have been computed and are presented for two examples of blades with biconvex parabolic arc sections of radially tapering thickness. Blade shapes that are required to achieve a zero thickness, uniform chordwise loading, constant work spanwise loading are also presented for two examples. In addition, corresponding surface pressure distributions are given. The flow relative to the blade tips has a high subsonic Mach number in the examples that have been computed. The results suggest that at near-sonic relative tip speeds the effective blade shape is dominated by the thickness distribution, with the lift distribution playing only a minor role. Author

**N72-11001#** Deutsche Gesellschaft fuer Luft- und Raumfahrt, Stuttgart (West Germany).
**ROTOR FLOW AND FLIGHT MECHANICS OF HINGELESS ROTORS [ROTORDURCHSTROEMUNG UND FLUGMECHANIK DES GELENKLOSEN ROTORS]**
Jun. 1971 284 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Comm. on Helicopters and Am. Helicopter Soc. Meeting, Ottobrunn, West Ger., 9 Dec. 1970
(DLR-MITT-71-12) Avail: NTIS; ZLDI Munich: 59.65 DM

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2. INFLUENCE OF DIFFERENT PARAMETERS (LIKE JET CONTRACTION, VORTEX CORE DIAMETER) UPON ROTOR DOWNWASH CALCULATION. APPLICATION TO THE CASE OF AN AUXILIARY WING J. W. Fuhr (DFVLR, Stuttgart) p 76-107 refs (See N72-11003 02-01)

3. INFLUENCE OF THE WAKE GEOMETRY ON THE VELOCITY AND LOAD DISTRIBUTION OF VTOL PROPELLERS G. Schultheiss (Ver. Flugtech. Werke-Fokker G.m.b.H., Munich) p 108-129 refs (See N72-11004 02-01)

4. LINEAR AERODYNAMIC ROTOR THEORY S. Wagner, K. Gehr, and W. Gradl (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Ger.) p 130-174 refs (See N72-11005 02-01)

5. RECOVERY ROTOR WITH VARIABLE BLADE LENGTH W. Benner and G. Engel (Dornier-Werke G.m.b.H., Friedrichshafen, West Ger.) p 175-209 refs (See N72-11006 02-01)

6. THEORETICAL CONSIDERATIONS OF A SPRING HINGED ROTOR OF VARIABLE FLAPPING STIFFNESS AND CONSTANT PHASE SHIFT W. Kugler (Dornier-Werke G.m.b.H., Friedrich-

shafen, West Ger.) p 210-240 refs (See N72-11007 02-01)
7. THE STABILITY- AND CONTROL BEHAVIOR OF THE HINGELESS BOELKOW ROTOR SYSTEM H. Huber (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Ger.) p 241-282 refs (See N72-11008 02-01)

N72-11002# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
**SURVEY OF DIFFERENT MODELS FOR COMPUTING THE FLOW OF A LIFTING ROTOR [UEVERBLICK UEBER VERSCHIEDENE MODELLE ZUR BERECHNUNG DER ROTORDURCHSTROEMUNG]**
Alfred Kussmann *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 7-75 refs In GERMAN; ENGLISH summary (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

Several methods for computing the induced velocity field and blade loads of a lifting rotor are given, especially in the forward flight regime, with particular consideration of the different wake model configurations. Author (ESRO)

N72-11003# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
**INFLUENCE OF DIFFERENT PARAMETERS (LIKE JET CONTRACTION, VORTEX CORE DIAMETER) UPON ROTOR DOWNWASH CALCULATION. APPLICATION TO THE CASE OF AN AUXILIARY WING [EINFLUSS VERSCHIEDENER PARAMETER (WIE STRAHLKONTRAKTION, WIRBELKERNDURCHMESSER USW.) AUF DIE ROTORABWINDBERECHNUNG. ANWENDUNG AM BIESPIEL EINES ENTLASTUNGSFLUEGELS]**
J. W. Fuhr *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 76-107 refs In GERMAN; ENGLISH summary (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

Some changes in the geometry of a rotor wake model with helical vortex lines were introduced in order to study the influence upon rotor downwash velocity distribution by parameter variation. The parameters varied were: diameter of near field vortices, flapping, rotor speed, and contraction of rotor radius. The velocity distribution at an infinite span wing, placed in the downwash flow, is calculated, and the interaction between wing and rotor is determined by computing the velocity distribution at the rotor. ESRO

N72-11004# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Munich (West Germany).
**INFLUENCE OF THE WAKE GEOMETRY ON THE VELOCITY AND LOAD DISTRIBUTION OF VTOL PROPELLERS [EINFLUSS DER NACHLAUFGEOMETRIE AUF DIE GESCHWINDIGKEITS- UND LASTVERTEILUNG VON VTOL-PROPELLERN]**
G. Schultheiss *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 108-129 refs In GERMAN (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

To determine the velocity and load distribution of VTOL propellers, a method was employed with discrete slipstream vortex stress. In using this method, the assumption of the length of the wake is a difficulty, this having repercussions on the exactitude of the relationships in the propeller plane. As the length of the wake determined the computing time, two examples were taken for upright and fast flight with a known three-bladed propeller. Induced angle of incidence, circulation distribution, thrust distribution, and the distribution of the ratios of thrust and power coefficients are compared with the results obtained from the Goldstein method. ESRO

N72-11005# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
**LINEAR AERODYNAMIC ROTOR THEORY [ZUR LINEAREN AERODYNAMISCHEN ROTORTHEORIE]**
S. Wagner, K. Gehr, and W. Gradl *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 130-174 refs In GERMAN (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

The mathematical models of a few known linear aerodynamic rotor theories and their basic physical assumptions are discussed. The principles and vortex models of an aerodynamic lifting surface and lift line theories for helicopter rotors are examined. The computing effort and obtainable accuracy for those theories which can be treated numerically are compared. Theoretical and practical thrust distribution generally correspond, and clearly show the advantages and disadvantages of the applied vortex models. It is shown that improvements in physical characteristics are easily obtained in the numerical treatment of a theory. ESRO

N72-11006# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**RECOVERY ROTOR WITH VARIABLE BLADE LENGTH [BERGEROTOR MIT VERAENDERLICHER BLATTLAENGE]**
W. Benner and G. Engel *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 175-209 refs In GERMAN (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

A variable rotor, which can be used for recovery and soft landing of an aerospace vehicle such as a missile is described. The compound recovery system can be used as: a tail control surface in fast flight with conventional controllability of the side and elevator rudders; a propeller in transition, after unlocking of the control surface support and adjusting of the surfaces; and a rotor for descent and landing after centrifugal emergence of the blade extensions and insertion of full cyclic controllability. Wind tunnel tests of the rotor are reported. ESRO

N72-11007# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**THEORETICAL CONSIDERATIONS OF A SPRING, HINGED ROTOR OF VARIABLE FLAPPING STIFFNESS AND CONSTANT PHASE SHIFT [THEORETISCHE BETRACHTUNGEN UEBER EINEN FEDERGELENKSROTOR VARIABLER SCHLAGSTEIFIGKEIT UND KONSTANTER PHASENVERSCHIEBUNG]**
W. Kugler *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 210-240 refs In GERMAN (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

A rotor system with elastically attached blades in theoretically investigated for varying the flight mechanical properties while retaining constant phase shift for cyclic control. This result may be obtained if the flapping stiffness of the rotor can be reduced to relatively small values in flight when the phase shift between vibration excitation and action is changed. For good controllability of a helicopter, the obtainable moment, for a stick deviation in a certain direction, should work about the center of gravity in the same or nearly the same direction. Investigations involving the use of many parameters to obtain constant phase shift with a rotor model, and with a projected Dornier rotor system, are reported. ESRO

N72-11008# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
**THE STABILITY- AND CONTROL BEHAVIOR OF THE HINGELESS BOELKOW ROTOR SYSTEM [DAS STABILITAETS- UND STEUERUNGSVERHALTEN DES GELENKLOSEN ROTORS SYSTEM BOELKOW]**
H. Huber *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 241-282 refs In GERMAN (See N72-11001 02-01)
Avail: NTIS; ZLDI Munich: 59,65 DM

The controllability, vibration damping, and static and dynamic stability of helicopters with hingeless rotors are examined. The feedback effects resulting from the special construction of

the blades are described. In addition to elastic feedback effects based on the direct flapping angle feedback, torsional coupling effects are explained, appearing when the center of gravity and the aerodynamic center of the blade profile are shifted. The results of parametric studies, showing the influence of such blade-integrated feedback systems on control and stability characteristics of the hingeless rotor, are given, and the obtainable variation in flight-mechanical properties of rotors is shown. Tests with the BO-105 helicopter verify the treatment developed.
ESRO

N72-11009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SUBSONIC AND TRANSONIC PRESSURE DISTRIBUTIONS AROUND A BLUFF AFTERBODY IN THE WAKE OF A 120 DEG CONE FOR VARIOUS SEPARATION DISTANCES**
James Wayne Sawyer and Charles F. Whitcomb Washington Nov. 1971 70 p refs
(NASA-TN-D-6569; L-7937) Avail: NTIS CSCL 20D

A wind-tunnel investigation was conducted at free-stream Mach numbers from 0.20 to 1.00 and Reynolds numbers, based on maximum afterbody diameter, from 2.25 million to 6.90 million on solid models of an attached inflatable decelerator (AID) concept. Tests were conducted to obtain static and ram surface pressure distributions about the basic shapes and at various separation distances between the 120 deg conical forebody and the inflated afterbody shape. The resulting data were used to study the feasibility of extracting a payload from a conical forebody by means of an AID. Author

N72-11010*# Lockheed-Georgia Co., Marietta.
**MATHEMATICAL MODEL FOR TWO-DIMENSIONAL MULTI-COMPONENT AIRFOILS IN VISCOUS FLOW**
W. A. Stevens, S. H. Goradia, and J. A. Braden Jul. 1971 167 p Supplement to NASA-CR-1843
(Contract NAS1-9143)
(NASA-CR-1843) Avail: NTIS CSCL 20D

Appendices on customer utilization of card images and the program listing as used on a CDC 6600 computer are presented. For Cr-1843, see N71-33140. N.E.N.

N72-11011# National Physical Lab., Teddington (England). Aerodynamics Div.
**THE VORTEX DRAG OF A SWEPT WING WITH PART-SPAN FLAPS**
H. C. Garner Sep. 1970 22 p refs
(NPL-AERO-1324; ARC-32395; Perf-2945) Avail: NTIS

Two theoretical methods of calculating the vortex drag factor from a prescribed spanwise loading and a novel third method, on the reverse-flow principle without a definitive spanwise loading, are applied to an untapered swept wing with symmetrically deflected outboard flaps. Results are consistent within + or - 1/2. The third method is used to study the large influence of flap span and chord. Author (ESRO)

N72-11012# National Physical Lab., Teddington (England). Aerodynamics Div.
**CONVERGENCE OF CURRENT ROUTINES FOR EVALUATING DOWNWASH AT A LIFTING SURFACE**
Doris E. Lehrian and H. C. Garner Sep. 1970 25 p refs
(NPL-AERO-Note-1095; ARC-32397) Avail: NTIS

Subsonic lifting-surface methods are used, with increasing numbers of spanwise integration points, to calculate downwash at the center line of rectangular wings with elliptic spanwise loading; simplified formulae are derived. Each method has its pattern of convergence, expressible as a single curve for arbitrary aspect ratio and chordwise position. Given a leading-edge singularity, high aspect ratio and leading-edge proximity combine to worsen the rate of convergence. Author (ESRO)

N72-11013# National Physical Lab., Teddington (England). Aerodynamics Div.
**THE EFFECT OF LEADING-EDGE WEDGE ANGLE ON THE FLOW OVER A FLAT PLATE IN A HYPERSONIC LOW-DENSITY GAS-STREAM**
S. C. Metcalf and C. J. Berry 15 Sep. 1970 18 p refs
(NPL-AERO-Note-1094; ARC-32356) Avail: NTIS

An experimental study was made of the under-wedge angle effects on the flow over sharp flat plates in a hypersonic, rarefied stream. It is shown that changes in this angle significantly affect the pressure distribution and shock shape and that the magnitude and extent of the effect increases with wall temperature.
Author (ESRO)

N72-11014# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**AIR CONDENSATION EFFECTS AT 8.5 M MEASURED ON THE DRAG AND THE WAKE OF A MAGNETICALLY SUSPENDED 20 DEG CONE**
J. F. W. Crane London Aeron. Res. Council 1971 17 p refs Supersedes RAE-TR-70022; ARC-32346
(ARC-CP-1177; RAE-TR-70022; ARC-32346) Avail: NTIS; HMSO: 25p; PHI $1.00

Schlieren pictures of the near wake of a 20 deg cone and drag measured by magnetic balance both show effects of air condensation at temperatures below that predicted. Above this level, supersaturated air may be used by hypersonic testing with complete absence of effects due to air condensation.
Author (ESRO)

N72-11015# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**SONIC BANG MEASUREMENTS DURING EXERCISE SUMMER SKY**
D. R. B. Webb, F. L. Hunt, and R. J. Pallant London Aeron. Res. Council 1971 17 p
(ARC-R/M-3659; RAE-TR-67313; ARC-30164) Avail: NTIS; HMSO: 48 p; PHI: $2.15

During July 1967, a series of supersonic flights were made over three areas in southern England under the code name exercise summer sky. The object was to observe public reaction to sonic bangs, in order to build up some information of the consequences of overflying parts of the country with supersonic transport aircraft. The RAE was asked to participate by measuring the sonic bang pressure waveforms at selected points in each of the three areas. One of the selected points in each area was in the nominal focus area of the flight paths, and for this purpose a ship was used as a monitoring station because the flight paths were arranged so that the focus areas occurred at sea. The recorded waveforms are shown and discussed, together with details of the aircraft tracks and relevant meteorological conditions. Author (ESRO)

N72-11016# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**WIND TUNNEL MEASUREMENTS AT 2.47 M OF THE MUTUAL AERODYNAMIC INTERFERENCE BETWEEN A GUIDED BOMB AND ITS BOOST UNIT DURING THE SEPARATION PHASE**
J. A. Lang London Aeron. Res. Council 1971 76 p refs
(ARC-CP-1161; RAE-TN-AERO-2822; ARC-25060) Avail: NTIS HMSO: £1; PHI: $4.05

Loads on boost motors in the vicinity of a guided bomb were measured over a range of positions and incidences likely to occur during separation in order to provide data from which the trajectory may be determined. The loadings and local pressures induced on the bomb by the aerodynamic interference from the boosts were also measured. The influence of deflected rear surfaces on the boosts was investigated as a means of limiting the boost incidence, attained through the angular momentum acquired after release of the forward constraint. Author (ESRO)

N72-11017# Aeronautical Research Associates of Princeton, Inc., N.J.
**ON THE AERODYNAMIC FORCES OF OSCILLATING TWO DIMENSIONAL LIFTING SURFACES Final Report**
John E. Yates and John C. Houbolt Dec. 1970 53 p refs
(Contract AF 49(638)-1640; AF Proj. 9782-01)
(AD-726132; ARAP-156; AFOSR-TR-71-1079) Avail: NTIS CSCL 10/1

The lift on a two-dimensional airfoil that oscillates in translation and pitch and is subject to a sinusoidal gust is calculated. The high frequency asymptotic behavior of the lift due to motion and gust is derived in the case of incompressible and compressible flow. The magnitude of the lift is asymptotically smaller in all cases when compressibility is considered.
Author (GRA)

# 02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-11018* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VARIABLE GEOMETRY ROTOR SYSTEM Patent**
John F. Ward, inventor (to NASA) Issued 13 Jul. 1971 5 p Filed 28 Aug. 1969 Supersedes N70-22185 (08 - 09, p 1572)
(NASA-Case-LAR-10557; US-Patent-3,592,559;
US-Patent-Appl-SN-853746; US-Patent-Class-416-121;
US-Patent-Class-416-115; US-Patent-Class-416-127;
US-Patent-Class-416-130; US-Patent-Class-416-149;
US-Patent-Class-416-200) Avail: US Patent Office CSCL 01C

The rotor system described is designed to control the nonuniform wake shed from a given rotor blade impinging upon the other blades of the rotor system. The rotor system utilizes blade sets which are of a different diameter than another blade set in the system. The azimuth spacing between the blade sets can be varied while the aircraft is in flight. The vertical spacing between the blade sets can also be changed. A mechanism is provided for collective pitch control of the blade sets. The planform of blade sets, as well as the configuration of their tips, are varied. Official Gazette of the U.S. Patent Office

N72-11019# Federal Aviation Administration, Oklahoma City, Okla.
**SIXTH ANNUAL INTERNATIONAL AVIATION MAINTENANCE SYMPOSIUM. THE AVIATION MAINTENANCE ENVIRONMENT IN THE 1970'S**
1970 311 p refs Symp. held at Oklahoma City, Okla., 8-10 Dec. 1970
Avail: NTIS HC $6.00/MF $0.95

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2. IMPROVING THE READABILITY OF MAINTENANCE MANUALS W. Jablonski (Boeing Co., Morton, Pa.) 34 p (See N72-11021 02-34)

3. HARNESSING THE DIGITAL COMPUTER FOR AIRCRAFT MAINTENANCE R. F. Cook (LTV Aerospace Corp., Dallas, Tex.) 12 p (See N72-11022 02-08)

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7. OPERATING LOGIC: NEW DATA AND TRAINING CONCEPT DEVELOPMENTS OF THE APOLLO PROGRAM J. T. Waggoner (GE Co., Houston, Tex.) 29 p ref (See N72-11026 02-02)

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14. THE GENERAL AVIATION MAINTENANCE OUTLOOK FOR THE SEVENTIES S. J. Green (Gen. Aviation Manufacturers Assoc., Wash., D.C.) 6 p (See N72-11033 02-02)

15. PROJECTED MAINTAINABILITY ADVANTAGES OF SOLID STATE ELECTRICAL POWER MANAGEMENT AND SOLID STATE CONTACTLESS SWITCHING SYSTEMS T. S. Miller (LTV Aerospace Corp., Dallas, Tex.) 31 p refs (See N72-11034 02-10)

16. PACIFIC AIRMOTIVE CORPORATION ACCESSORY RELIABILITY PROGRAM D. Snyder (Pacific Airmotive Corp., Burbank, Calif.) 5 p (See N72-11035 02-15)

N72-11020# Eastern Air Lines, Inc., Miami, Fla.
**COMPUTER APPLICATION STRATEGY FOR CONTROL OF AIRLINE MAINTENANCE IN THE SEVENTIES c08**
J. P. Burke, J. P. DiBella, and J. B. Sabel *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 16 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The requirements and benefits of applying computer techniques to aircraft maintenance operations are discussed. It is determined that the aircraft maintenance computer applications strategy for the 1970 decade should be as follows: (1) develop and implement control, rather than information systems, (2) focus control systems at the lowest effective level where maintenance events are taking place, and (3) integrate management information systems for policy control by evolution rather than by superimposing them on the environment. Author

N72-11021# Boeing Co., Morton, Pa.
**IMPROVING THE READABILITY OF MAINTENANCE MANUALS c34**
Walter Jablonski *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 34 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

A discussion of methods for improving the readability of aircraft maintenance manuals is presented. Techniques for evaluating the understandability of written instructions are described. Requirements for and advantages of improved readability are discussed. Author

**N72-11022#** LTV Aerospace Corp., Dallas, Tex. Systems Effectiveness Dept.
**HARNESSING THE DIGITAL COMPUTER FOR AIRCRAFT MAINTENANCE** c08
R. F. Cook *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 12 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The application of digital computers to the maintenance of commercial aircraft avionics systems is discussed. The specific use of computers for detection of impending failures, fault isolation, and verification of fault correction is described. It is concluded that proper use of computer techniques will result in increased availability, lower maintenance costs, and improved flight safety. Author

**N72-11023#** Boeing Co., Seattle, Wash.
**FACILITIES, EQUIPMENT AND TOOLS TO SUPPORT WIND BODIED AIRPLANE MAINTENANCE IN THE SEVENTIES** c11
M. Doyle *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 27 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The definition and documentation of facility, equipment, and tool requirements for maintenance of large commercial aircraft are presented. The main impact of the large aircraft is the increased magnitude of the planning task. A general review of the requirements using the 747 aircraft as an example is provided. Author

**N72-11024#** Wall Colmonoy Corp., Detroit, Mich.
**REMANUFACTURING OF JET ENGINE COMPONENTS EMPLOYING BRAZING TECHNIQUES** c28
Robert Leon Peaslee *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 10 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The application of brazing techniques for the remanufacture of jet engine components is discussed. The benefits derived from brazing of jet engine parts are described. Welding of hot section components and precision braze repair procedures are presented. Author

**N72-11025#** Automation Industries, Inc., Danbury, Conn. Materials Evaluation Group.
**NONDESTRUCTIVE INSPECTION: AN AIRCRAFT MAINTENANCE TOOL OF THE SEVENTIES** c11
Earl C. Mayes *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The application of nondestructive techniques to maintenance of large commercial aircraft is discussed. Procedures described are: (1) radiography, (2) ultrasonic inspection, (3) eddy current, (4) magnetic particle, and (5) in penetrant. Present operations and future possibilities are presented. Author

**N72-11026#** General Electric Co., Houston, Tex.
**OPERATING LOGIC: NEW DATA AND TRAINING CONCEPT DEVELOPMENTS OF THE APOLLO PROGRAM**
J. T. Waggoner *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 29 p ref (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The application of Apollo Project data and training concepts to the maintenance of large commercial aircraft is discussed. Subjects presented are: (1) functional understanding of system and support equipment, (2) physical characteristics of system and support equipment, and (3) procedural directions for troubleshooting and fault isolation. Author

**N72-11027#** Douglas Aircraft Co., Inc., Long Beach, Calif.
**MAINTENANCE FAULT ISOLATION IN THE SEVENTIES**
H. W. Adams and H. Bayer *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 8 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The Pattern of Cockpit Indication (PCI) system for simplified, coordinated, in-flight and on-ground fault isolation is described. Simulator tests have shown PCI to provide up to an 18 to 1 improvement over systems now in use. The principles and methods of analysis, development, simulation, and presentation are described and the benefits associated with the use of PCI by the airlines are presented. Author

**N72-11028#** Lockheed-California Co., Burbank.
**STREAMLINED L-1011 FAULT ISOLATION TECHNIQUES**
W. W. Watkins *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 19 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The incorporation of built-in-test-equipment and condition monitoring capabilities for aircraft systems and components is discussed. The development of fault isolation and problem correction equipment used by the L-1011 aircraft is reported. The prime feature of the technique is the graphic presentation of functional check data through the medium of logic and schematic diagrams. Elimination of conventional test procedures facilitiates the use of the maintenance data. Duplication of fault isolation tasks is avoided and appropriate maintenance procedures are followed. Author

**N72-11029#** Societe Nationale Industrielle Aerospatiale, Paris (France). Concorde Support Div.
**AN APPLICATION OF MODERN MAINTENANCE CONCEPTS AND SAFETY ANALYSIS TO THE MULTI-NATIONAL CERTIFICATION OF A SUPERSONIC AIRCRAFT**
J. Hass *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 24 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The composition and functions of an organization for multinational certification of supersonic commercial aircraft are described. The organization is primarily concerned with establishment and enforcement of design and maintenance requirements which will promote safer aircraft operation. Author

**N72-11030#** Pratt and Whitney Aircraft, East Hartford, Conn.
**MODULAR DESIGN CONCEPT IMPROVES JET ENGINE MAINTAINABILITY** c28
George P. Adamson *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 32 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

Improvements in the maintenance of jet aircraft engines by incorporation of modular construction is discussed. In the JT9D engine, consideration was given to avoiding maintenance problems by simplification of structural features. Airline experience in maintaining the JT9D engines is presented and comparisons are made with previous engine maintenance operations. Author

**N72-11031#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
**ACCESSIBILITY: THE KEY TO GOOD POWERPLANT MAINTAINABILITY**
R. W. Hevener *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 16 p refs (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

Of the several design criteria required to achieve good maintainability features, accessibility is considered the key one because of its contribution to the airline operator in reducing overall maintenance costs. This contribution is provided to the operator in three major areas: (1) increased inspection accessibility and capability permitting the airlines' maintenance personnel to monitor parts condition, trouble-shoot, and isolate problem areas, (2) easy access by attachment and arrangement features to permit rapid removal and replacement of engine and aircraft accessories, and, (3) modular construction of the basic engine components to permit replacement either on the airplane or off at line maintenance stations, resulting in significant reduction of

the elapsed time that an engine is out of commission and is returned to spare inventory status. In addition to making a major contribution in reducing maintenance costs, good accessibility features aid in reducing overall operating costs through improved dispatch reliability and reduced airplane down time, thereby permitting increased ultilization of the airplane. Author

N72-11032# Beechcraft-Hawker Corp., London (England).
**MAINTAINING THE BH 125 IN THE SEVENTIES**
Ian F. Keith *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 20 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

Maintenance procedures for the Beech Hawker 125 commercial jet aircraft are presented. Subjects discussed are: (1) maintenance schedule, (2) nondestructive testing, (3) instruction handbooks, and (4) inspection requirements. Author

N72-11033# General Aviation Manufacturers Association, Washington, D.C.
**THE GENERAL AVIATION MAINTENANCE OUTLOOK FOR THE SEVENTIES**
Stanley J. Green *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 6 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

Predictions of aircraft maintenance procedures and requirements for the remainder of the 1970's are presented. Emphasis is placed on the need for improvement in aircraft safety and methods for improving the safety record. The expected expansion in numbers of aircraft and changes in aircraft power plants are described. Author

N72-11034# LTV Aerospace Corp., Dallas, Tex.
**PROJECTED MAINTAINABILITY ADVANTAGES OF SOLID STATE ELECTRICAL POWER MANAGEMENT AND SOLID STATE CONTACTLESS SWITCHING SYSTEMS** c10
T. S. Miller *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 31 p refs (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

Maintenance advantages of solid state electrical logic management and distribution of electrical power are described. The specific advantages discussed are those associated with the capabilities of the system to: (1) create a favorable power environment for avionics, (2) lower total systems maintenance by favorable interfacing of electrical signal and control functions, and (3) exploit the favorable failure delta of solid state switching. The discussions are predicted on a contemporary aircraft electrical power management and distribution system and a solid state contactless system. The possible variations of the two systems are infinite, therefore the discussions are limited to comparisons between aircraft systems based on the requirements of MIL-STD-704 and a solid state system specifically concepted to operate with power sources of a MIL-STD-704 system. Military Standard 704 in this case is deemed to connotate a constant frequency generator operating from a variable speed power take off with the necessary control and management required to deliver electrical power to an aircraft's AC and DC buses.
Author

N72-11035# Pacific Airmotive Corp., Burbank, Calif.
**PACIFIC AIRMOTIVE CORPORATION ACCESSORY RELIABILITY PROGRAM (PACAR)** c15
David Snyder *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

The establishment of a program for improved reliability through new maintenance procedures applied to aircraft accessories is discussed. The steps taken to insure adequate inspection and repair are described. The effects of various environmental conditions on component reliability are reported.
Author

N72-11036# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**STUDYING THE COHERENT AND INCOHERENT STRUCTURES OF AERODYNAMICALLY GENERATED NOISE [ETUDES DES STRUCTURES COHERENTES ET INCOHERENTES DE BRUIT D'ORIGINE AERODYNAMIQUE]**
Jean-Francois deBelleval, Patrick Harel, Jean Lambourion, and Mariano Perulli 1971 5 p refs In FRENCH Presented at the 7th Intern. Congr. on Acoustics, Budapest, 18-26 Aug. 1971
(ONERA-TP-983) Avail: NTIS

The coherent and incoherent structures of aerodynamically generated noise is outlined using theoretical models. Space-time correlations are then used to analyze the pressure near the field of a compressor and the infrared emission of a hot jet. From this analysis the source structure is determined. Author

N72-11037# Douglas Aircraft Co., Inc., Long Beach, Calif.
**A FLIGHT SIMULATOR STUDY OF STOL TRANSPORT DIRECTIONAL CONTROL CHARACTERISTICS** Final Report
Robert A. Berg, W. Allen Shirley, Gary L. Teper (Systems Tech., Inc., Hawthorne, Calif.), and Samuel J. Craig (Systems Tech., Inc., Hawthorne, Calif.) Jun. 1971 134 p refs Prepared in cooperation with Systems Tech., Inc., Hawthorne, Calif.
(Contract DOTFA-70-WA-2395)
(FAA-RD-71-81) Avail: NTIS

A systematic investigation was conducted of STOL transport terminal area directional control characteristics to identify the significant considerations and to establish appropriate directional control criteria. The investigation consisted of an analysis of existing data and moving-base flight simulator program using the NASA S-16 Moving Cab Transport Simulator. The simulator test program covered a broad range of lateral and directional aerodynamic characteristics representative of typical STOL transport aircraft. The study revealed the existence of an appreciable interaction between the roll and the heading control tasks which suggests that roll-mode damping requirements should be specified in terms of the heading delay characteristics. Lateral control sensitivity tests were conducted which corroborated previously obtained results. Author

N72-11038*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**THREE-TRACK RUNWAY AND TAXIWAY PROFILES MEASURED AT INTERNATIONAL AIRPORTS E AND F**
Albert W. Hall Washington Nov. 1971 100 p refs
(NASA-TN-D-6567; L-7977) Avail: NTIS CSCL 01E

Three-track runway and taxiway profiles are presented for use in studies of airplane response to ground roughness. This report presents the tabulated and plotted data for two international airports (designed airports E and F). Author

N72-11039# Joint Publications Research Service, Washington, D.C.
**SYSTEMS OF AIRCRAFT AUTOMATIC CONTROL**
I. A. Mikhalev, B. N. Okoyemov, I. G. Pavlina, M. S. Chikulayev, and N. M. Eydnov 27 Oct. 1971 47 p Transl. into ENGLISH from the book "Sistemy Avtomaticheskogo Upravleniya Samoletom" Moscow, Mashinostroyeniye Publishing House, 1971 p 2-9, 87-128
(JPRS-54332; UDC-697.7.05.001) Avail: NTIS

Methods of analysis and calculation of the basic parameters of aircraft automatic control system components are discussed. Analysis and calculation are done with the problem stated in linear form. The materials are reduced to simple, practical calculation equations. The report contains 22 bibliographic references. Author

N72-11040# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
**NOISE-ABATEMENT FLIGHT PROFILES FOR CTOL AND V/STOL AIRCRAFT**

P. Hamel 1971 49 p refs
(DLR-FB-71-10; DK-658.517.2) Avail: NTIS; DFVLR, Porz, West Ger.: 12,50 DM

An overall survey of problems associated with noise abatement flight profiles for CTOL and V/STOL aircraft is presented. It is shown how aircraft design parameters and control variables, such as thrust vector control, power loading, and aerodynamic efficiency, influence the intensity of the noise source. The distance between noise source and observer, and the noise exposure duration may be influenced by steep climbout combined with moderate thrust and steep landing. Several stability and control problems due to steep noise abatement landing procedures are discussed. ESRO

**N72-11041*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SYSTEM FOR STABILIZING TORQUE BETWEEN A BALLOON AND GONDOLA Patent Application**
David K. Studenick, Allen L. Tyler, and Walter Squillari, inventors (to NASA) Filed 24 Mar. 1971 19 p
(NASA-Case-GSC-11077-1; US-Patent-Appl-SN-127618) Avail: NTIS CSCL 01C

A description is given of the systems used to minimize the torque in the suspension of a gondola carried by a balloon. The balloon is connected to the stabilized gondola by a parachute with shroud lines. The top of the parachute is connected to the balloon via an active bearing having a motor driven in response to the output of a torque sensor connected between the shroud lines and gondola. In response to the sensed torque exceeding a predetermined level, pulses are periodically applied to the active bearing to limit the torque buildup between the balloon and gondola to a low value. Author

**N72-11042#** Royal Aircraft Establishment, Farnborough (England).
**CATEGORY 2: A SIMULATION STUDY OF LOW VISIBILITY APPROACHES AND LANDINGS AT NIGHT**
A. D. Brown Mar. 1971 105 p refs
(RAE-TR-71044; UDC-629.13.089) Avail: NTIS

The design, execution and results of a flight simulator experiment to investigate the problems of aircraft operating in Category 2 conditions. Both military and airline pilots participated and over 500 manual approaches were performed using a flight director. The effects of decision height, contact time, lateral offset, visual sequence and visual segment on the approach success (the ratio of landings to approaches) are examined and a curve relating this parameter to visual segment, the predominant factor, is determined. The influence of different visual sequences on pilot performance during the approach and landing is also considered and some observations are made about the crew techniques employed during the experiment; techniques which appeared to have certain deficiencies. Author ESRO

**N72-11043#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**CIVIL AIRCRAFT AIRWORTHINESS DATA RECORDING PROGRAMME. MANOEUVRE LOADS DURING TRAINING AND TEST FLYING**
G. E. King London Aeron. Res. Council 1971 13 p refs Supersedes RAE-TR-70226; ARC-32850
(ARC-CP-1176; RAE-TR-70226; ARC-32850) Avail: NTIS; HMSO: 20p; PHI: $0.80

Using continuous photographic trace records, the maneuver accelerations experienced in 35 hours of training flying were counted and measured to provide an estimate of the total numbers and magnitude of loads for a fleet's flying training over a five year period. These data are compared with counting accelerometer data giving the estimated total number of gust plus maneuver loads for five years of revenue flying by the same fleet. Both estimates were found to be of the same order in the number and magnitude of loads although the ratio of training to revenue flying hours was one in fifty. The particular test flight analyzed, which included an unusually large number of stalls, produced approximately as many extreme negative accelerations as one year's revenue flying. Author (ESRO)

**N72-11044#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**AN HYPOTHESIS FOR THE PREDICTION OF FLIGHT PENETRATION OF WING BUFFETING FROM DYNAMIC TESTS ON WIND TUNNEL MODELS**
D. G. Mabey London Aeron. Res. Council 1971 33 p refs Supersedes RAE-TR-70189; ARC-32684
(ARC-CP-1171; RAE-TR-70189; ARC-32684; UDC-533.6.013.43:533.693) Avail: NTIS; HMSO: 45p; PHI $1.80

Buffeting coefficients appropriate to the maximum flight penetration of wing buffeting for both transport and fighter type aircraft are deduced from the comparison of flight observations and measurements of unsteady wing-root strain on stiff wind tunnel models. The necessary buffeting coefficients are derived rapidly from the unsteady wing-root strain measurements. The tunnel unsteadiness is used as a given level of aerodynamic excitation to calibrate the model response at the wing fundamental frequency. Author (ESRO)

**N72-11045#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**BRIEF FLIGHT TESTS OF CROSSWIND LANDINGS AND SIDESTEP MANOEUVRES ON THE BAC 221 AIRCRAFT**
W. F. Dee, R. Rose, and O. P. Nicholas London Aeron. Res. Council 1971 32 p refs Supersedes RAE-TR-68251; ARC-30959
(ARC-CP-1168; RAE-TR-68251; ARC-30959) Avail: NTIS; HMSO: 45p; PHI: $1.80

A brief flight study has been made of crosswind landings and sidestep maneuvers in the BAC 221 slender-wing research aircraft. Using the crabbed approach for crosswind landings, and the coordinated S-turn for sidestep maneuvers, pilots found both tasks straightforward. The time required to complete a sidestep is little longer than for unswept aircraft, despite the oscillatory roll response to aileron inputs of the BAC 221. Results of similar tests performed in a ground based simulator show good qualitative agreement. Author (ESRO)

**N72-11046#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**FLIGHT AND WIND-TUNNEL TESTS ON AN AERODYNAMICALLY COMPENSATED PITOT-STATIC HEAD FOR THE BAC 221 AIRCRAFT**
C. S. Barnes and O. P. Nicholas London Aeron. Res. Council 1971 47 p refs Supersedes RAE-TR-69013; ARC-31370
(ARC-CP-1167; RAE-TR-69013; ARC-31370) Avail: NTIS; HMSO: 65p; PHI: $2.65

The BAC 221 aircraft is fitted with a special pitot-static head, insensitive to incidence, and aerodynamically compensated on similar principles to the head fitted to the Concorde, to minimize aircraft pressure field effects. Tests have been made on the head covering the Mach number range 0.2 to 1.4 in two wind tunnels and at three altitudes in flight. The compensation significantly reduces the static pressure errors at high subsonic and transonic speeds but small errors remain at low subsonic and supersonic speeds. The sensitivity to incidence and sideslip, of the pitot and static pressures sensed, is satisfactorily low. The manufacturer's prediction of the head performance agrees reasonably well with tunnel results but poorly with flight results. It appears that the prediction of the aircraft pressure field is inaccurate. Author (ESRO)

**N72-11047#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**SOME FULL-SCALE MEASUREMENTS OF THE FLOW IN THE WAKE OF A HANGAR**
M. J. Colmer London Aeron. Res. Council 1971 30 p refs Supersedes RAE-TR-70202; ARC-32863

(ARC-CP-1166; RAE-TR-70202; ARC-32863) Avail: NTIS; HMSO: 40p; PHI: $1.85

An experiment to measure the flow behind a full-scale building is described. The results of one set of data show that the whole wake was slowly oscillating and that the turbulence intensity in the wake was greater than upstream. An hypothesis for the wake motion is put forward and the effect of the wake behind a building on conventional and V/STOL aircraft is considered. Author (ESRO)

N72-11048# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

**PILOTED SIMULATOR INVESTIGATIONS OF FLIGHT NEAR ZERO RATE OF CLIMB SPEED**

T. Wilcock London Aeron. Res. Council 1971 39 p refs Supersedes RAE-TR-70016; ARC-32171

(ARC-CP-1165; RAE-TR-70016; ARC-32171) Avail: NTIS; HMSO: 55p; PHI: $2.45

The problems associated with flight at or below the zero rate of climb speed (V sub ZRC) have been investigated in piloted flight simulations of a supersonic transport aircraft and of the BAC 221 slender wing research aircraft. The accuracy of determining V sub ZRC by piloted tests was examined, and the height losses in recoveries from below V sub ZRC were compared with theoretical calculations. Agreement was very good for one simulation, though not quite as good for the other. Tests showed that height losses are generally minimized by a rapid recovery maneuver, but no detailed study was made of the optimum recovery technique. Author (ESRO)

N72-11049# Royal Aircraft Establishment, Bedford (England). Aero F Dept.

**A THEORETICAL STUDY OF HEIGHT CONTROL IN FLIGHT CLOSE TO THE GROUND AS AFFECTED BY ELEVATOR LIFT AND COCKPIT POSITION**

W. J. G. Pinsker London Aeron. Res. Council 1971 19 p refs Supersedes RAE-TR-69097; ARC-31488

(ARC-R/M-3662; RAE-TR-69097; ARC-31488) Avail: NTIS; HMSO: 50p; PHI: $2.25

During the final landing approach pilots are often observed to attempt tight control of flight path by coarse elevator usage. It us shown by theoretical analysis that this form of control is inherently conducive to instability and that adverse elevator lift is detrimental in this situation. However, if the pilot is located in a cockpit far forward of the center of gravity of the aircraft, he perceives false motion cues which tend to reduce the possiblity of this form of pilot-induced oscillation. Author (ESRO)

N72-11050# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

**THE AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF A FULL SCALE ROTOR OPERATING AT VERY HIGH ADVANCE RATIOS AND DURING START/STOP OPERATION Final Report, Feb. 1968 - May 1970**

Andrew R. Trenka May 1971 183 p refs

(Contract DAAJ02-68-C-0017; DA 1F1-62204-A-139)

(AD-727653; CAL-BB-2595-S-1; USAAVLABS-TR-70-60) Avail: NTIS CSCL 01/3

The purpose of this program was to study the aerodynamic and aeroelastic behavior of a rigid two-bladed rotor system operating at steady-state advance ratios up to approximately 1.5. Also to be investigated was the operation of this rotor during periods of acceleration and deceleration which were representative of the starting/stopping sequence of a stowable rotor. The objective of the program was accomplished by conducting wind tunnel tests in the NASA-Ames 40- x 80-foot wind tunnel on a full-scale rotor. Hub forces and moments, blade pressure distributions (chordwise and spanwise), and blade flatwise, chordwise and torsional moments were measured. The experimental results were used to correlate with existing theory. GRA

N72-11051# Tri-State Transportation Commission, New York.

**METROPOLITAN AIRCRAFT NOISE ABATEMENT POLICY STUDY, JOHN F. KENNEDY INTERNATIONAL AIRPORT, NEW YORK, NEW YORK**

1970 21 p Sponsored in part by HUD

(PB-200164; TSTC-2053-3580-1M) Avail: NTIS CSCL 01B

Alternative measures or combinations of measures to provide relief from aircraft noise in affected communities around John F. Kennedy International Airport are considered, and methods for reducing aircraft-noise problems are recommended. A study was made of present land use, local development policies and codes, sound insulations of structures, redevelopment, future land-use alternatives, legal aspects and airport operations. Author (GRA)

N72-11052# National Transportation Safety Board, Washington, D.C.

**BRIEFS OF ACCIDENTS INVOLVING CORPORATE/EXECUTIVE AIRCRAFT: US GENERAL AVIATION, 1968**

Jun. 1971 58 p

(PB-201439; NTSB-AMM-71-3) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates, and the briefs of accidents involving corporate/executive aircraft. Author (GRA)

N72-11053# Trans-Sonics, Inc., Burlington, Mass.

**HELICOPTER LIFT-MARGIN SYSTEM, VOLUME 2 Final Report**

Bradford W. Edgerton and Sidney B. Williams Dec. 1970 149 p Sponsored in part by ECOM

(Contract N00014-68-C-0300; NR Proj. 213-067)

(AD-725207; JANAIR-70121B-Vol-2; Rept-80001-Vol-2) Avail: NTIS CSCL 01/4

Helicopter power requirements are generally maximum when hovering out of ground effect. Thus, takeoff and landing maneuvers are the most critical, since the power requirements may not be clear to the pilot at the time he must make the corresponding decisions. Power deficiencies at takeoff or landing are very hazardous. To maximize safety of takeoff and landing operations, a system has been devised which presents to the pilot his lift margin, a figure which represents the excess weight which could be accommodated under locally-existing barometric pressure, outside-air-temperature conditions, and rotor system condition. The system includes two kinds of compensators of which the first corrects available engine torque for ambient conditions and the second makes a similar correction for the ratio of gross weight to required power. Author (GRA)

N72-11054# Air Force Flight Test Center, Edwards AFB, Calif.

**THEORY OF THE MEASUREMENT AND STANDARIZATION OF IN-FLIGHT PERFORMANCE OF AIRCRAFT Final Technology Document**

Everett W. Dunlap and Milton B. Porter Apr. 1971 281 p refs

(AD-725741; AFFTC-TD-71-1) Avail: NTIS CSCL 14/2

The contents of this report were prepared to give those engaged in aircraft flight test an understanding of the analysis required to arrive at standardized flight data. Toward that end, considerable attention was given to the derivation of equations. In contrast to earlier reports, simplifying assumptions were not made; rather, efforts were made to keep the derivations of all equations as nearly exact as possible. Emphasis has been placed on climbs and level accelerations since these tests, particularly for supersonic aircraft, consume a large part of a test program and require calculations which are much more lengthy than for other tests. The information in this document was the basis for the development of uniform digital computer programs which are being constructed for use in processing flight data and correcting it to standard conditions. These programs have been given the name Uniform Flight Test Analysis System (UFTAS). Author (GRA)

N72-11055# Goodyear Aerospace Corp., Akron, Ohio.
**DEFINITION OF TETHERED BALLOON SYSTEMS**
Qhilip F. Myers and Jerome J. Vorschek 31 Mar. 1971 92 p refs
(Contract F19628-71-C-0091; AF-Proj.7659)
(AD-725708; GER-15246; Scientific-1) Avail: NTIS CSCL 01/3

An analytical investigation of the behavior of tethered balloons is in progress. The report covers balloon system definition for three design altitudes, 5,000, 10,000, and 20,000 feet above sea level. Three balloon shapes being considered are the Vee-Balloon, the Bateman and Jones (BJ) barrage balloon, and Goodyear Aerospace Corporation Model No. 1649 single-hull balloon. Tether constructions are Columbian Rope Company's NOLARO utilizing prestretched polyester filaments, and 9 US Steel Corporation's Amgal-Monitor AA wire ropes. Eight specific balloon/cable combinations are defined, covering the three design altitudes. Total cable curve, downwind displacement, etc., have been calculated by computer program and results are tabulated. Aerodynamic characteristics, weight, inertias, and dynamic charscteristics are developed and tabulated.
Author (GRA)

N72-11056# Dynamic Science, Irvine, Calif.
**ANALYSIS OF AIRCRAFT FUEL TANK FIRE AND EXPLOSION HAZARDS Final Report, 1 Jul. 1969 - 15 Dec. 1970**
Thomas C. Kosvic, Laurence B. Zung, and Melvin Gerstein Mar. 1971 88 p refs
(Contract F33615-69-C-1895; AF Proj. 3048)
(AD-725027; SN-166-F; AFAPL-TR-71-7) Avail: NTIS CSCL 13/12

Under simulated flight environments, fuel/air ratios at various locations of the ullage space were determined using in-line gas chromatograph measurement. Using the shallow tank experimental data showed that during ascent and cruise portion of the flight profile, uniform fuel/air mixtures were found to exist within the entire ullage volume. Significant fuel/air gradients existed during the descent portion of the flight profile, with mainly air near the vent inlet. Evaporation lag was observed during ascent and level flight when liquid Jet A fuel was maintained at 80 degree F. When the liquid fuel temperature was increased to 120F, evaporation rate was found to be rapid enough that the evaporative lag phenomena was no longer observed. By vibrating the fuel tank, it greatly increased the rate of off-gassing of dissolved air in the liquid fuel. This in turn significantly changed the fuel/air ratio in the ullage space. Two separate and complementary models were developed to predict fuel/air concentrations within the ullage. Author (GRA)

N72-11057# American Nucleonics Corp., Woodland Hills, Calif.
**ANALYSIS AND DESIGN STUDY OF A PILOT ASSIST SYSTEM FOR HELICOPTERS Final Report, Jan. - Dec. 1970**
Arthur J. Welch and Edward L. Warren Apr. 1971 190 p refs
(Contract DAAJ02-70-C-0019)
(AD-725590; ANC-72R-14; USAAVLABS-TR-71-11; Task-1F162204A13905) Avail: NTIS CSCL 01/3

The purpose of the work performed under this contract was to conduct an analytical investigation of advanced flight control systems (AFCS) requirements for light and medium size helicopters and to design a pilot assist system based on the analytical results. The pilot assist system (PAS) design goal was to develop an AFCS that is relatively light and inexpensive and that can be readily installed in a UH-1B. Author (GRA)

N72-11058# Serendipity Associates, Arlington, Va. Eastern Operations Div.
**AIRPORT/AIRCRAFT SYSTEM COMPUTER MODELS BURROUGHS 5500-MOD 0, IBM 7094-MOD 1**
Jun. 1971 56 p refs Sponsored by Dept. of Transportation
(PB-201432; DOT-OST-ONA-71-4) Avail: NTIS CSCL 09B

The report contains a computer listing of the airport/aircraft system computer model developed during the course of a study on transporation noise. GRA

N72-11059# Boeing Co., Philadelphia, Pa. Vertol Div.
**HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS. VOLUME 1 Final Report**
Kirk G. Rummel Apr. 1971 317 p
(Contract DAAJ02-70-C-0039)
(AD-725595; D210-10207-1; USAAMRDL-TR-71-18A; Task-1F162203A14301) Avail: NTIS CSCL 01/3

The report covers a study to identify optimum reliability problem identification and demonstration test concepts for helicopter dynamic components, in order to facilitate formulation of cost-effective reliability test programs for future helicopters. Detailed failure mode test technique problem identification capability and cost data are presented from CH-47 helicopter development experience to aid in calculating specific test costs for future development programs. Sample test plans are presented for two helicopters representing size extremes. A plan is outlined for revising selected existing design and test military specifications and supplementing them with additional handbooks and specifications. Author (GRA)

N72-11060# Oceanics, Inc., Plainview, N.Y.
**MODEL STUDIES OF HELICOPTER TAIL ROTOR FLOW PATTERNS IN AND OUT OF GROUND EFFECT Final Technical Report**
August F. Lehman Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Apr. 1971 32 p refs
(Contracts DAAJ02-68-C-0069; DAAJ02-68-C-0103; DA Proj. 1-F-162204-A-14232; DA Proj. 1-F-1-62204-A-14231)
(AD-725591; Rept-70-79; USAAVLABS-TR-71-12) Avail: NTIS CSCL 01/3

Water tunnel studies of a model helicopter which entailed a visualization of the main and tail rotor wakes, the inflow patterns, and their subsequent interactions as the wind velocity and wind heading were changed resulted in a significant gain in knowledge ultimately applicable to direction control of helicopters. Of significant interest was the impingement of the main rotor wake with a ground plane, its subsequent spreading outward in a radial manner and the roll-up of the wake into a standing vortex at the outer edge of this radial expansion of the wake.
Author (GRA)

N72-11061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SELECTING THE BASIC PARAMETERS OF CIVIL AIRCRAFT FOR SPECIFIED RANGES AND COMMERICAL LOAD**
G. N. Yun 3 Mar. 1971 22 p refs Transl. into ENGLISH from "Primeniye Matematicheskikh Metodov v Ekonomicheskikh Issledovaniyakh i Planirovanii, Seminar" Kiev, no. 1, 1968 p 64-75
(AD-727231; FTD-MT-24-353-70) Avail: NTIS CSCL 01/3

A digital computer method of selecting the basic parameters of aircraft, using freight charges as a criterion, is described.
Author (GRA)

# 03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N72-11062* Taag Designs, Inc., College Park, Md.
**RECOVERY OF RADIATION DAMAGED SOLAR CELLS THROUGH THERMAL ANNEALING Patent**

Pao-Hsien Fang, George Meszaros, and William G. Gdula, inventors (to NASA) Issued 3 Aug. 1971 4 p Filed 2 May 1969 Continuation-in-part of US Patent Appl. SN-588634, filed 21 Oct. 1966 Sponsored by NASA
(NASA-Case-XGS-04047-2; US-Patent-3,597,281; US-Patent-Appl-SN-843251; US-Patent-Class-136-206) Avail: US Patent Office CSCL 10A

The apparatus used onboard spacecraft to thermally anneal defects from solar cells is described. The greenhouse effect is employed to heat the cells to the desired annealing temperature bf 400 C. Official Gazette of the U.S. Patent Office

**N72-11063*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SUPPORTING DATA PACKAGE FOR TR 32-1541, EFFECTS OF STORAGE TEMPERATURES ON SILICON SOLAR CELL CONTACTS**
Paul A. Berman and Robert K. Yasui 15 Oct. 1971 129 p refs
(Contract NAS7-100)
(NASA-CR-123360; JPL-TM-33-497) Avail: NTIS CSCL 10A

A series of summary curves is presented for cells having various contact systems, depicting the effects of temperature exposure as a function of time on the electrical and mechanical characteristics. Each curve represents the results obtained from a minimum of 32 and a maximum of 1104 individual data inputs and includes the 95% confidence limits associated with each time-temperature combination for which measurements were obtained. The curves are useful for detailed analysis and comparison of the behavior of the contact system as a function of the environmental conditions studied. Author

**N72-11064*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ATTACHING COVER GLASSES TO SOLAR CELLS Patent Application**
Jacob D. Broder, inventor (to NASA) Filed 21 Jun. 1971 8 p
(NASA-Case-LEW-11065-1; US-Patent-Appl-SN-154930) Avail: NTIS CSCL 10A

A transparent plastic film, that is substantially unaffected by ultraviolet radiation exposure and does not degrade in its bonding characteristics under particulate radiation bombardment, is described. The film, used as a binding agent between a cover glass and a silicon solar cell, is composed of a copolymer fluorinated ethylene propylene. E.H.W.

**N72-11065#** Avco-Everett Research Lab., Everett, Mass.
**EXPERIMENTAL RESEARCH ON A 400 kW HIGH POWER DENSITY MHD GENERATOR Final Technical Report, Jun. 1967 - Dec. 1970**
O. K. Sonju, J. Teno, J. W. Lothrop, and S. W. Petty Wright-Patterson AFB, Ohio AFAPL May 1971 195 p refs
(Contract F33615-67-C-1019; AF Proj. 3145)
(AD-725739; AFAPL-TR-71-5) Avail: NTIS CSCL 10/2

An MHD Generator Facility was designed, constructed and placed in operation. The Facility is described and operating, maintenance, safety and calibration instructions and procedures are given. The Facility was utilized to measure conductivity of hydrocarbon-oxygen combustion gases seeded with cesium salts. A factor of two improvement in electrical conductivity as compared with potassium seeding was observed. A high specific power output (0.5 MW/kg/sec) MHD generator at the 300-400 kilowatt output level was designed and built for cyanogen-oxygen operation. The design of the generator is described, as are the modifications to the AERL Mark II facility which were required in order to test the generator. In spite of the system imperfections encountered the ability of an MHD generator to produce high specific output in the submegawatt power range with conventional hydrocarbon fuels was conclusively demonstrated. Author (GRA)

**N72-11066#** Eagle-Picher Co., Joplin, Mo. Electrons Div.
**MAGNESIUM/META-DINITROBENZENE RESERVE-TYPE BATTERY FOR FIELD APPLICATION: MINIATURE RESERVE TYPE MAGNESIUM BATTERY FOR OPERATION FROM PLUS 125 F TO MINUS 40 F Final Report, Mar. 1970 - Apr. 1971**
Jerry L. Russell Jun. 1971 58 p refs
(Contract DAAB07-70-C-0121; DA-Proj. 1-T-662705-A-053)
(AD-725575; ECOM-0121-F) Avail: NTIS CSCL 10/3

The first part of the report describes the design and testing of a primary reserve type battery employing a magnesium/magnesium perchlorate/meta-dinitrobenzene system, which was hoped to yield a power density in excess of that of the manganese dioxide system but was determined to have serious technical problems which limit its use and efficiency. The best power density obtained by the described design was 26 watt-hrs/pound. The second part of the report describes the design and testing of a reserve-type miniature 2.5 volt magnesium battery for powering second generation night vision devices such as goggles and crew served weapon sights. The battery occupies 0.59 cubic inches, weighs 0.64 ounces and yields as high as 0.75 watt-hrs. It can operate in temperature ambients ranging from +125F to -40F. Author (GRA)

**N72-11067#** Northeastern Univ., Boston, Mass.
**RESEARCH IN SOLAR ENERGY CONVERSION Final Report, 1 Oct. 1966 - 30 Sep. 1970**
Welville B. Nowak 19 Jan. 1971 162 p refs
(Contract F19628-67-C-0119; AF Proj. 8659)
(AD-726114; AFCRL-71-0163; Task-8659-01-01) Avail: NTIS CSCL 10/2

The following topics related to photovoltaic solar-energy conversion were investigated: Transient Response of Momentarily Reverse-Biased Solar Cells, Electrodifussion Effects in Semiconductors, Effect of Electric Fields and Charged Particle Impingement on Planar-Edge-Growth of Single Crystal Silicon Films on Amorphous Quartz, and Heterojunction Photovoltaic Solar Cells. Author (GRA)

# 04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

**N72-11068** National Lending Library for Science and Technology, Boston Spa (England).
**SOLAR NAVIGATION OF BIRDS [SOLNECHNAYA NAVIGATSIYA PTITS]**
G. K. Nazarchuk, A. B. Kistyakovskii, L. A. Smogorzhevskii, and L. M. Shulman Oct. 1971 19 p refs Transl. into ENGLISH from Vestn. zool. (Moscow), v. 6, 1969 p 3-15
(NLL-RTS-6632) Avail: Natl. Lending Library, Boston Spa, Engl.: 6 NLL photocopy coupon

Tests to determine the ability of birds to navigate based on observation of solar elevation and azimuth are discussed. A numerical analysis of the process by which birds maintain orientation in flight during solar position changes is presented. It is concluded that birds do not rely solely on visual perception of the sun for navigation, but the exact manner in which navigation is performed is still not certain. Author

**N72-11069*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ELECTRON TUNNELING AS A BASIS FOR SEMICONDUCTION IN PROTEINS**
Lawrence Flax and Dennis Flood Washington Nov. 1971 21 p refs
(NASA-TN-D-6559; E-6483) Avail: NTIS CSCL 06B

Electron tunneling is investigated as a possible mechanism for the conduction of electrical current in solids composed of protein molecules. An intermolecular potential barrier is assumed which takes into account the applied electric field and the

possibility of image charge effects. The WKB approximation is used to calculate the net tunneling current density and resulting conductivity. The results suggest that electron tunneling per se is not a suitable mechanism for explaining the observed conductivities in such materials. Author

N72-11070*# Scientific Translation Service, Santa Barbara, Calif.
**ON THE INHERITANCE OF THE ENZYMATIC ACTIVITIES OF LACTATE DEHYDROGENASE AND MALATE DEHYDROGENASE IN HUMAN ERYTHROCYTES [ZUR VERERBUNG DER ENZYMAKTIVITAETEN DER LACTAT-DEHYDROGENASE UND MALAT-DEHYDROGENASE IN MENSCHLICHEN ERYTHROZYTEN]**
H. Haug and A. Gathof Washington NASA Nov. 1971 9 p refs Transl. into ENGLISH from Blut (Munich), v. 14, 1966 p 10-15
(Contract NASw-2035)
(NASA-TT-F-14016) Avail: NTIS CSCL 06P

Activities of the enzymes lactate dehydrogenase and malate dehydrogenase were determined in erythrocyte hemolysates from 20 families with 40 adults and 35 children. Agreement of the enzyme activities for the genetically different parents was found in 30% of the cases for lactate dehydrogenase and in 45% of the cases for malate dehydrogenase. Of the 35 children, the relations did not vary by more than 10% in 63% for lactate dehydrogenase and in 68% for malate dehydrogenase. The question of genetic or metabolic dependence of the variability of enzyme activities was discussed. Author

N72-11071*# National Aeronautics and Space Administration, Washington, D.C.
**MEASUREMENT OF VISUAL REACTION TIME IN BOTH POSITIVE AND TRANSVERSE G [UNTERSUCHUNGEN UEBER AENDERUNGEN DER OPTISCHEN REAKTIONS-ZEIT DES MENSCHEN BEIM EINWIRKEN HOHER FLIEHKRAEFTE]**
H. Burmeister Oct. 1971 12 p refs Transl. into ENGLISH from Luftfahrtmedizin, v. 3, 1939 p 277-284
(NASA-TT-F-14000) Avail: NTIS CSCL 06S

Different subjects were tested for their visual reaction time while under centrifugal force. When this force was in a chest back direction then at 4G there was a slight increase in reaction time and scatter. At 8G the reaction time was definitely prolonged and the scatter noticeably increased. Wnen the centrifugal force was in a head to buttocks direction then an increased reaction time and scatter took place at 3G, while at 4.5G it led to omitting reactions. Author

N72-11072# Joint Publications Research Service, Washington, D.C.
**IMMUNOLOGICAL PROBLEMS OF CLOSED ENVIRONMENTS AND GNOTOBIOLOGY**
K. A. Lebedev and R. V. Petrov 27 Oct. 1971 26 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 71, no. 2, 1971 p 235-252
(JPRS-54331; UDC-577.391:612.017.1) Avail: NTIS

Ways of preventing reduction of the organism's immune system under conditions of prolonged space flight are discussed. The conclusion is drawn that the most efficient method is enteral immunization of astronauts with sets of antigenic drugs in the form of dietary supplements (antigenic supplements). It is expedient to regulate the astronauts' indigenous microflora before takeoff by applying the principles for creating specific pathogen free (SPF) animals. Upon the astronauts' return to earth after flight gradual restoration of their microflora must be ensured by means of microbial sluicing in isolation chambers. Author

N72-11073# International Academy of Aviation and Space Medicine, Brussels (Belgium).
**NINETEENTH INTERNATIONAL CONGRESS OF AVIATION AND SPACE MEDICINE: ABSTRACTS**
Oct. 1971 97 p refs Conf. held in Tel-Aviv, Israel, 24-29 Oct. 1971
Avail: NTIS

A series of abstracts on space, civil aviation, and clinical medicine are given. Data also cover aerospace aspects of environment pollution, neuropsychological and medical criteria for selecting space crews, medical aspects of escape, recovery, and evacuation, and heart stress and fatigue. E.H.W.

N72-11074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**BACTERIAL ADENOSINE TRIPHOSPHATE AS A MEASURE OF URINARY TRACT INFECTION Patent Application**
Emmett Chappelle and Grace L. Picciolo, inventors (to NASA) Filed 30 Apr. 1971 35 p
(NASA-Case-GSC-11092-2; US-Patent-Appl-SN-139250) Avail: NTIS CSCL 06E

A method is provided for determining bacterial levels in urine samples, which method depends on the quantitative determination of bacterial adenosine triphosphate (ATP) in the presence of non-bacterial ATP. After the removal of non-bacterial ATP, the bacterial ATP is released by cell rupture and is measured by an enzymatic bioluminescent assay using an enzyme obtained from the firefly. Author

N72-11075*# Minnesota Univ., Minneapolis. Space Science Center.
**ENVIRONMENTAL MICROBIOLOGY AS RELATED TO PLANETARY QUARANTINE Semiannual Progress Report**
Irving J. Pflug Jun. 1971 74 p refs
(Grant NGL-24-005-160)
(NASA-CR-123326; SAPR-6) Avail: NTIS CSCL 06M

The experiments carried out to determine the effects of temperature and relative humidity on the survival rate of Bacillus subtillis var. niger spores are reported. The experiments were conducted in environmental chambers at temperatures of 75 and 90 C. Data are also included on the survival characteristics of the spores suspended in sucrose solutions at 90 C with water activities of 0.99, 0.9, and 0.85 Author

N72-11076# Cincinnati Univ., Ohio. Dept. of Environmental Health.
**STUDIES ON THE MECHANISM OF THE EFFECT OF IONIZING RADIATIONS ON THE OLFACTORY SYSTEM Final Report, 1 Jan. 1967 - 31 Dec. 1970**
Gary P. Cooper 24 May 1971 7 p refs
(Contract AT(11-1)-1669)
(COO-1669-7) Avail: NTIS

Experiments on the effects of radiation on single olfactory bulb neutrons in the rabbit showed that beta irradiation of the olfactory epithelium evoked responses of olfactory bulb neurons whereas beta irradiation of the olfactory bulb itself did not. Studies on quantitative relationships between X-ray parameters and the response of olfactory bulb neurons showed that the response to X-rays may be described by functions similar to those characteristic of other sensory responses. It was found that X-rays do not evoke responses in nasal branches of the trigeminal nerve of rats. The respiratory rate of anesthetized and unanesthetized rats was increased following olfactory stimulation by X-rays. Results of studies on effects of high dose X-irradiation on olfaction in rabbits showed that the peripheral olfactory system appears to be considerably more radioresistant than the central nervous system. The response of olfactory bulb neutrons to X-rays as a function of nasal oxygen concentration was studied; it was found the response to X-rays was unaffected until the oxygen concentration decreased to about 2%. Author

N72-11077# Sandia Labs., Albuquerque, N.Mex.
**SANDIA LABORATORIES PLANETARY QUARANTINE PROGRAM Quarterly Progress Report, period ending 31 Mar. 1971**

R. S. Gillespie Mar. 1971 75 p refs
(TID-25725; QPR-20) Avail: NTIS

The effectiveness of a combination of heat (at temperatures less than 100 C) with gamma or X-radiation delivered at dose rates of approximately 10 krad/hr was investigated for the sterilization of space vehicles. The effects of humidity on the sensitivity of Bacillus subtilis spores, heat and radiation sensitivities of heat-resistant bacterial spores found occurring naturally in soil at Cape Kennedy, and a comparison of the effects of gamma and X-radiation dose rates on the inactivation of spores of B. subtilis were studied. The combined application of heat and ionizing radiation provides a greater degree of inactivation in a given time period than either heat or irradiation separately during the same period of time. The mechanisms involved in the synergistic effect of heat and ionizing radiation for the inactivation of biological materials were investigated. NSA

N72-11078# Oak Ridge National Lab., Tenn.
**MOLECULAR ANATOMY (MAN) PROGRAM, PART 1 Semiannual Progress Report, 1 Sep. 1970 - 28 Feb. 1971**
Jul. 1971 229 p refs Sponsored in part by Natl. Cancer Inst., Natl. Inst. of Gen. Med. Sci., and Natl. Inst. of Allergy and Infectious Diseases
(Contract W-7405-eng-26)
(ORNL-4683-Pt-1; sapr-2) Avail: NTIS

Progress of clinical investigations into cancer prevention, infectious diseases, body fluids, and electrophoresis is described. A.L.

N72-11079# Los Alamos Scientific Lab., N.Mex.
**SURVEY OF TECHNIQUES EMPLOYED TO DEFINE AEROSOL RESPIRABLE DUST CONCENTRATION AND PARTICLE-SIZE CHARACTERISTICS, VOLUME 2**
Harry J. Ettinger Jun. 1971 14 p ref
(Contract W-7405-eng-36)
(LA-4249-Vol-2) Avail: NTIS

A questionnaire survey was conducted to evaluate air sampling procedures employed by AEC licenses and governmental radiological health agencies. Air sampling is generally performed, but relatively little sampling data define respirable concentration, or aerosol particle-size characteristics. However, the importance of these parameters in defining potential health hazards is acknowledged. The need for standardization of air sampling procedures and respirable dust definitions is indicated. Author

N72-11080# Federation of American Societies for Experimental Biology, Bethesda, Md.
**ADAPTATION OF VESSELS OF THE TELENCEPHALON TO GRAVITATIONAL OVERLOADS IN THE HEAD-PELVIS DIRECTION**
N. I. Zotova 1971 14 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Moscow), v. 59, no. 7, 1970 p 59
(PB-200183T; NS-402) Avail: NTIS CSCL 06S

Exposure of an untrained animal to intolerable gravitational overloads leads to considerable morphological changes in the blood vessels of the telencephalon. Prolonged, systematic overloads of a training character lead to adaptation of animals to the overloads, and the vessels of the telencephalon of the trained animal show only negligible changes after exposure to overloads which are not tolerated by untrained animals. Important factors for adaptation of vessels of the telencephalon to hypergravitation are the duration of action of the overloads in the training program and the interval of time after training before the gravitational stress is imposed. Author (GRA)

N72-11081# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**MEDICAL AND BIOLOGICAL RESEARCH ON SOVIET SPACESHIP-SATELLITES**
12 Mar. 1971 9 p Transl. into ENGLISH from Pam. for the 1970 Exhibit of Achievements of the Natl. Economy (Moscow), 1970 p 2-4
(AF Proj. FTD-60101)
(AD-727940; FTD-HT-23-62-71; Task-DIA-T69-01-15) Avail: NTIS CSCL 06/3

The pamphlet discusses the flights of various biological objects, especially dogs, in the period preceding Soviet manned space flight. A table of launches and the animals carried in them is given. There is some general information on the gross response of the animals to spaceflight factors. Author (GRA)

N72-11082# Wisconsin Univ., Madison. Dept. of Veterinary Science.
**ECOLOGICAL AND AEROSPACE MEDICAL ASPECTS OF VIRUS DISEASES Technical Report, 1 Jul. 1970 - 30 Apr. 1971**
Robert P. Hanson 30 Apr. 1971 102 p refs
(Grant AF-AFOSR-1455-68)
(AD-726645; AFOSR-71-1954TR) Avail: NTIS CSCL 02/5

Although the ultimate goal of the research is to understand the epizootiology of vertebrate pathogens, an understanding of the ecology of these pathogens must be based on an understanding of the ecology of plant and animal communities. The report presents an inventory of the ecology of biting insects, birds and mammals. GRA

N72-11083# Defense Documentation Center, Alexandria, Va.
**RADIATION HAZARDS Report Bibliography, Apr. 1952 - Mar. 1971**
Jul. 1971 141 p refs
(AD-726900; DDC-TAS-71-32) Avail: NTIS CSCL 06/18

The references in this annotated bibliography pertain to the potential hazards related to electromagnetic radiation, radiological dosages, radioactive fallout, and contamination of both water and air supplies. Corporate author-monitoring agency, subject, and title indexes are provided. Author (GRA)

# 05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N72-11084* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MANUALLY ACTUATED HEAT PUMP Patent**
William D. Hutchinson, inventor (to NASA) Issued 17 Aug. 1971 6 p Filed 22 Oct. 1969 Sponsored by NASA
Supersedes N70-34725 (08 - 18, p 3302)
(NASA-Case-NPO-10677; US-Patent-3,599,443;
US-Patent-Appl-SN-868530; US-Patent-Class-62-467;
US-Patent-Class-62-56) Avail: US Patent Office CSCL 13A

A manually actuated heat pump is reported for use as an auxiliary device in selectively warming and cooling an ambient medium. The device is characterized by a pair of independently mounted rotatable hubs, interconnected through elastomeric bands which alternatingly elongate and contract to experience a continuously reversing heat transfer process, in accordance with the principles of the so-called Joule effect in rubber. The pump employs a fluid bath which receives the bands in selected states of elongation for effecting a heat transfer between the fluid of the bath and the bands. Selective preheating and precooling of the bands are achieved in a medium divorced from the ambient atmosphere and thus the reversibility of the transfer of energy within the atmosphere is controlled.
Official Gazette of the U.S. Patent Office

N72-11085* Weber Aircraft Corp., Burbank, Calif.
**COLLAPSIBLE APOLLO COUCH Patent**
David L. Johansen, Walter E. Cooper, and Liborio J. Ferrara, inventors (to NASA) Issued 13 Jul. 1971 10 p Filed 4 Feb.

1969 Sponsored by NASA
(NASA-Case-MSC-13140; US-Patent-3,592,505; US-Patent-Appl-SN-796358; US-Patent-Class-297-68; US-Patent-Class-297-232; US-Patent-Class-5-69; US-Patent-Class-285-410) Avail: US Patent Office CSCL 06K

A couch system for manned space vehicles is described. The system comprises a separable main frame structure and three individually foldable couches which are detachable. Each couch is supported by highly articulated frames which may be manipulated by individual occupants. The main frame and the couches may be dismantled, either completely or partially, and compacted for storage to provide more room for the occupants of the vehicle. One couch is additionally adjustable to a more upright position to facilitate operation of various controls and improve the occupant's view through a window.

*Official Gazette of the U.S. Patent Office*

N72-11086*# Louisiana State Univ., Baton Rouge. Bioengineering Research Facility.
**[MECHANISMS AND KINETICS OF CELLULOSE FERMENTATION FOR PROTEIN PRODUCTION] Progress Report, 1970 -1971**
C. A. Dunlap 1971 48 p refs
(Grant NGL-19-001-024)
(NASA-CR-123368) Avail: NTIS CSCL 06B

The development of a process (and ancillary processing and analytical techniques) to produce bacterial single-cell protein of good nutritional quality from waste cellulose is discussed. A fermentation pilot plant and laboratory were developed and have been in operation for about two years. Single-cell protein (SCP) can be produced from sugarcane bagasse--a typical agricultural cellulosic waste. The optimization and understanding of this process and its controlling variables are examined. Both batch and continuous fermentation runs have been made under controlled conditions in the 535 liter pilot plant vessel and in the laboratory 14-liter fermenters. Author

N72-11087*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**ERGOMETER Patent Application**
Gerald W. Crum and Richard J. Sauter, inventors (to NASA) Filed 26 May 1971 13 p
(NASA-Case-MSC-11561-1; US-Patent-Appl-SN-146490) Avail: NTIS CSCL 05E

A foot pedal operated exercising device containing a dynamometer formed of a linked pair of cylinders each containing a piston, us described. The upper portions of the two cylinders are joined together to provide a common fluid reservoir and each piston is provided with a one way check valve to maintain an adequate working fluid level. Fluid from the driven cylinder is transmitted to the other cylinder through a spring biased valve which takes the predominant portion of the pressure drop, thereby providing a constant force hydraulic dynamometer. Means are also provided to count the amount of piston travel. Author

N72-11088*# General Electric Co., Philadelphia, Pa. Space Div.
**MULTIPARAMETER VISION TESTER APPARATUS Patent Application**
Stacey R. Hunt, Robert J. Homkes, Wilmer B. Poteate, and Andrew C. Sturges, inventors (to NASA) Filed 7 Jul. 1971 70 p
(Contract NASw-1630)
(NASA-Case-MSC-13601-1; US-Patent-Appl-SN-160371) Avail: NTIS CSCL 05E

A compact vision testing apparatus is provided for testing a relatively large number of physiological characteristics of the eyes and visual system of a human subject. The head of the subject is inserted into a viewing port at one end of a light-tight housing containing various optical assemblies. Visual acuity and other refractive characteristics and ocular muscle balance characteristics of the eyes of the subject are tested by means of a retractable phoroptor assembly carried near the viewing port and a film cassett unit carried in the rearward portion of the housing, the latter selectively providing a variety of different visual targets which are viewed through the optical system of the phoroptor assembly. The visual dark adaptation characteristics and absolute brightness threshold of the subject are testsd by a projector assembly. A Dolman rod unit present in a box assembly tests the visual depth perception of the subject. A mechanism is also provided for testing the visual critical fusion frequency. Author

N72-11089# Vanderbilt Univ., Nashville, Tenn.
**DIGITAL SYSTEMS FOR DATA ACQUISITION AND STORAGE**
A. Bertrand Brill, Jon J. Erickson, and Charles E. Lindahl Apr. 1970 47 p refs
(Contract AT(40-1)-2401)
(ORO-2401-37; Conf-700516-4) Avail: NTIS

Digital systems for data acquisition and storage for medical imaging instruments including fixed probe systems, rectilinear scanners, stationary camera systems, and moving camera systems are discussed. Also, experience at Vanderbilt University with rectilinear scanners and Anger cameras is described. NSA

N72-11090# California Univ., Livermore. Lawrence Radiation Lab.
**RESPIRATORY CARTRIDGE EFFICIENCY STUDIES. 1: EXPERIMENTAL DESIGN**
Walter E. Ruch, Gary O. Nelson, Carl L. Lindeken, Robert G. Johnsen, and David J. Hodgkins 29 Apr. 1971 16 p refs Submitted for publication Supported by AEC
(UCRL-73166; Conf-710505-3) Avail: NTIS

A testing facility to produce test atmospheres of known composition was built. The cartridges are placed in a specially designed and constructed holder; and breakthrough times are determined by measuring the upstream and downstream concentrations, using dual flame ionization detectors. The breakthrough characteristics can be ascertained by using either a steady state condition or a cycling flow produced by a breath simulator. A standard cartridge was designed to evaluate system performance and to periodically check the system for reproducibility. Parameters to be studied include the effects of organic comopounds, concentration, work rate, temperature, and relative humidity on cartridge efficiency. Author

N72-11091# Human Resources Research Organization, Alexandria, Va.
**MAN IN CONTROL OF HIGHLY AUTOMATED SYSTEMS**
Harry L. Ammerman and William H. Melching May 1971 15 p Presented at 16th Ann. Army Human Factors Res. and Develop. Conf., Fort Bliss, Tex., Oct. 1970
(Contract DAHC19-70-C-0012)
(AD-727658; HUMRRO-PR-7-71) Avail: NTIS CSCL 05/8

The identification of what man should do as a decision maker and controller in the newly evolving man-machine systems is considered. Among the topics discussed are man's underlying basic functions in a complex system, task activities for individual jobs and their analyses, and training and the design of operational job positions. Author (GRA)

N72-11092# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**PRELIMINARY VEHICLE TESTS; INFLATABLE OCCUPANT RESTRAINT SYSTEMS. VOLUME 2: FINAL PROGRAM REPORT Final Report, 30 Jun. 1970 - 31 Mar. 1971**
James F. Martin and David J. Romeo Mar. 1971 168 p refs
(Contract DOT-FH-11-7621)
(PB-200876; CAL-YB-2990-K-2; DOT-HS-800-478) Avail: NTIS CSCL 13F

Sections concerning the test program, inflatable occupant restraint systems, test equipment, test procedures, test data processing and results, and discussion of results are presented. GRA

N72-11093# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**PRELIMINARY VEHICLE TESTS: INFLATABLE OCCUPANT RESTRAINT SYSTEMS. VOLUME 2: FINAL PROGRAM REPORT: APPENDIX A Final Report, 30 Jun. 1970 - 31 Mar. 1971**
Mar. 1971 163 p 3 Vol.
(Contract DOT-FH-11-7621)
(PB-200877; CAL-YB-2990-K-2A) Avail: NTIS CSCL 13F

Approximately 155 illustrations are presented that are grouped according to the type of information (e.g. dummy accelerations) and subgrouped according to test number and filter frequency. All filters are single order with corner frequencies as indicated. Author (GRA)

N72-11094# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**PRELIMINARY VEHICLE TESTS: INFLATABLE OCCUPANT RESTRAINT SYSTEMS. VOLUME 2: FINAL PROGRAM REPORT: APPENDIX B Final Report, 30 Jun. 1970 - 31 Mar. 1971**
Mar. 1971 144 p 3 Vol.
(Contract DOT-FH-11-7621)
(PB-200878; CAL-YB-2990-K-2B) Avail: NTIS CSCL 13F

Photographs are presented of all of the test vehicles used in the program; both pre-crash and post-crash. Author (GRA)

N72-11095# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**PRELIMINARY VEHICLE TESTS: INFLATABLE OCCUPANT RESTRAINT SYSTEMS. VOLUME 3: TEST PROCEDURES AND INSTRUMENTATION Final Report, 30 Jun. 1970 - 31 Mar. 1971**
James F. Martin and David J. Romeo Mar. 1971 143 p 3 Vol.
(Contract FH-11-7631)
(PB-200779; CAL-YB-2990-K-3) Avail: NTIS CSCL 13F

Descriptions are given of the test procedures, data acquisition techniques, and instrumentation used to carry out the objectives of the program. A brief procedural guide to IORS testing is presented which is aimed at providing a set of guidelines for similar types of test work. Author (GRA)

N72-11096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EFFECT OF REPRODUCTION SCALE ON PROBABILITY OF IMAGE RECOGNITION**
V. K. Pototskii 22 Mar. 1971 6 p Transl. into ENGLISH from Tekhn. Kino Televideniya (USSR), v. 14, no. 2, 1970 p 69
(AD-727457; FTD-HC-23-54-71) Avail: NTIS CSCL 06/16

For the range of spatial frequencies where the transmission function of the visual analyzer - the eye - is unlimited, the study of the dependence of the recognition probability of images transmitted on a noisy communication channel upon the scale of reproduction is not only of unquestioned practical interest, but also allows the following question to be answered: is the visual system an ideal averaging device, i.e., does the signal-to-noise ratio (and therefore, the probability of recognition remain constant) with a change of the angular dimensions of the specific distorted image. Author (GRA)

N72-11097# Naval Aerospace Medical Inst., Pensacola, Fla.
**STATE AND TRAIT ANXIETY IN THE STUDENT NAVAL AVIATOR WHO VOLUNTARILY WITHDRAWS FROM FLIGHT TRAINING**
Steven F. Bucky and Charles D. Spielberger 12 Apr. 1971 10 p refs
(MF Proj. 12.524.002)
(AD-727814; NAMRL-1132) Avail: NTIS CSCL 05/9

The purpose of the present study was to determine whether student aviators who voluntarily drop out of the naval aviation training program (DOR's) respond differently to measures of state and trait anxiety from the way in which a group of entering aviation officer candidates (AOC's) and a group of male college students respond. The results indicate that DOR's are: (1) lower in A-State and similar in A-Trait when compared to entering AOC's; and (2) similar in A-State and lower in A-Trait when compared to the male college students. Although significant differences between entering AOC's and DOR's were observed, the ultimate usefulness of the STAI in predicting DOR's must await further investigation. Author (GRA)

N72-11098# Air Force Human Resources Lab., Williams AFB, Ariz. Flying Training Div.
**WHAT'S NEW ON THE TRAINING HORIZON**
David O. Andersen and William V. Hagin Mar. 1971 28 p refs
(AF Proj. 1123)
(AD-727009; AFHRL-TR-71-36) Avail: NTIS CSCL 05/9

The paper describes new training technologies. It documents the potential of these technologies and simple and complex ground trainers for improving both the quality and efficiency of pilot training. Author (GRA)

N72-11099# Human Resources Research Organization, Alexandria, Va.
**HARDWARE PARAMETERS RELATED TO OPERATOR TRAINING CAPABILITIES**
Harold P. Bishop Jun. 1971 10 p Presented at the 16th Ann. Army Human Factors Res. and Develop. Conf., Fort Bliss, Tex., Oct. 1970
(Contract DAHC19-70-c-0012)
(AD-727857; HUMRRO-PP-9-71) Avail: NTIS CSCL 05/9

The research reported is part of an effort to identify critical human factors problems in the use of new night observation devices, and to develop effective techniques of training men in the use of these devices. Two techniques for training operators of the AN/TSS-7 long range night observation device are described and compared. Pictorial training aids were developed and evaluated; traditional platform instruction was compared with a videotaped instructional sequence. Author (GRA)

N72-11100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ALGORITHM FOR RECOGNIZING 40 WORDS ON A BESM-3M DIGITAL COMPUTER**
G. Ya. Vysotskii, B. N. Rudnyy, V. N. Trunin-Donskoy, and G. I. Tsemel 12 Feb. 1971 40 p refs Transl. into ENGLISH from Raboty po Tekhn. Kibernetike (USSR), no. 2, 1968 p 3-33
(FTD Proj. 6050205)
(AD-725013; FTD-MT-24-321-70; UR/3502-68-000-002; T68-05-02) Avail: NTIS CSCL 09/2

A study was made of an algorithm for recognizing 40 words on a BESM-3M computer to establish direct communication between man and machine. Of the 40 words pronounced by 20 speakers, 93 percent were recognized correctly. The average recognition time after a word was pronounced was 0.5 sec. The correctness of pronunciation was not controlled. Deviations from normal pronunciation were detected in the print-outs of the segmental sequences. Author (GRA)

N72-11101# Defense Documentation Center, Alexandria, Va.
**MEMORY: LONG AND SHORT TERM Report Bibliography, Jul. 1960 - Jan. 1971**
Jul. 1971 308 p refs
(AD-727300; DDC-TAS-71-34) Avail: NTIS HC $6.00/MF $0.95 CSCL 05/10

The annotated bibliography contains 226 references to reports and reprints from periodicals that analyze variables which affect the information processes of short and long term human memory. Empirical and theoretical techniques which study certain measurable characteristics about human performance and its limitations are also included, as well as studies concerned with the relationship between short term memory, long term memory and learning. Corporate Author-Monitoring Agency, Subject, and AD Number indexes are included. Author (GRA)

N72-11102# Stanford Univ., Calif. Dept. of Computer Science.
**[ARTIFICIAL INTELLIGENCE AND HEURISTIC PROGRAMMING RESEARCH]**
John McCarthy, Arthur Samuel, Edward Feigenbaum, and Joshua Lederberg Mar. 1971 84 p refs
(ARPA Order 457 Contract ARPA SD-183; Grant MH-06645-08)

(AD-724867; SU-CS-209; AIM-143) Avail: NTIS CSCL 06/4

An overview is presented of current research at Stanford in artificial intelligence and heuristic programming. This report is largely the text of a proposal to the Advanced Research Projects Agency for fiscal year 1972-3. Author (GRA)

N72-11103# Defense Documentation Center, Alexandria, Va.
**WATER: PURIFICATION AND DECONTAMINATION, A DDC BIBLIOGRAPHY, JULY 1952 - AUGUST 1969**
Jun. 1971 102 p refs
(AD-725610; DDC-TAS-71-30) Avail: NTIS CSCL 13/2

The bibliography consists of 76 annotated references to reports which were selected from the Defense Documentation Center's data bank covering the period from January 1953 through December 1970. The reports analyze the purification, distillation and decontamination of water. It includes the recycling of closed ecological systems for the potability of water by the use of ion exchange, filtration, disinfecting agents, and coagulation. The indexes are corporate author-monitoring agency, and subject. Author (GRA)

N72-11104# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**OXYGEN AND PROTECTIVE MASKS (AVIATION) Final Report**
17 May 1971 33 p
(Proj. AMCR-310-6; AMCR Proj. 310-6)
(AD-725540; MTP-7-2-086) Avail: NTIS CSCL 06/11

The procedure describes test methodology and testing techniques necessary to determine the technical performance and safety characteristics of aviation oxygen and protective masks and associated accessories to determine their suitability for service tests. Author (GRA)

N72-11105# Beta Industries, Inc., Dayton, Ohio.
**IMPACT AND VIBRATION TEST EQUIPMENT DESIGN AND EXPERIMENTATION Final Report, Mar. 1970 - Jun. 1971**
Norman S. Phillips, Richard S. Scranton, and Richard W. Carr Jul. 1971 40 p
(Contract F33615-70-C-1445; AF Proj. 7231)
(AD-726119; BII-210-15; AMRL-TR-71-62) Avail: NTIS CSCL 05/5

Test hardware was designed and fabricated which would permit biodynamic research to be conducted on both the AMRL IMPMODE and AMRL MONOMODE at their excitation limits. The existing Body Retraction Apparatus was modified to permit qualification and human testing. An instrumentation system including transducers, signal conditioners, and recorders was assembled to support the testing associated with the foregoing. Qualification testing was accomplished on all three devices with human testing conducted on the Body Retraction Apparatus. The program produced rugged test hardware for use in biodynamic experiments to investigate vibration exposure limits for human subjects and the inertial response of individual body segments during impact and vibration. In addition, a device and technique for investigating human tolerance to forcible retraction was developed and preliminary data collected. Author (GRA)

N72-11106# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**RESCUE EQUIPMENT, PERSONNEL AIRCRAFT CRASH Final Report**
10 May 1971 42 p
(AMCR Proj. 310-6)
(AD-725541; MTP-7-2-090) Avail: NTIS CSCL 06/7

The procedure defines methods for evaluating equipment utilized for rescue operations of an aircraft crash, including clothing and tools. Author

N72-11107# Webb Associates, Yellow Springs, Ohio.
**PROTECTION OF AIRCREWS FROM HIGH TEMPERATURES: USE OF A WATER COOLED GARMENT FOR HEAT BALANCE STUDIES IN MAN Final Report**
Paul Webb Jul. 1971 11 p refs
(Contract F44620-70-C-0045)
(AD-727222; AFOSR-71-1982TR) Avail: NTIS CSCL 06/17

A water-cooled suit was developed for use as a direct calorimeter with error of approximately one percent when heat loss was matched to heat production over a full 24-hour metabolic cycle. The new suit was coupled with a previously developed metabolic rate monitor in a series of human experiments. It was shown that during 30-35 continuous hours of monitoring body heat content is not constant, even at rest, and there is constant swing of heat storage of some magnitude storage is generally ten percent of metabolic rate. Secondly, it was found that there are sinusoidal rhythms in heat production and heat loss, which are matched but out of phase, and the phase shift can explain the established circadian rhythm in rectal temperature. These data are of considerable interest to USAF laboratories studying physiological adjustments following flights over several time zones, changes in biological rhythms during prolonged flights, and in designing new protective equipment. Author (GRA)

# 06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N72-11108 National Lending Library for Science and Technology, Boston Spa (England).
**STUDIES ON POWDER FIRE EXTINGUISHING AGENTS. PART 3: ACTION OF CHEMICAL POWDERS ON MATERIALS SUCH AS WOOD AT THE TIME OF THERMAL DECOMPOSITION [FUNMATSU SHOKA-ZAI NI KAN SURU KENKYU (SONO 3): MOKUZAI NADO NO NETSU-BUNKAI TOKI NI OKESU YAKUKIN FUMATSU NO SAYO]**
Shobo Kenkyusho Hokoku Aug. 1971 18 p refs Transl. into ENGLISH from Shobo Kenkyusho Hokoku (Japan), no. 29, 1969 p 1-11
(NLL-RTS-6554) Avail: Natl. Lending Library, Boston Spa, Engl.: £ 1.80; 6 NLL photocopy coupons

Powders have been used for some time in firefighting when the material has cellulose as the main component. Most of these powders are based on ammonium phosphate, and the extinguishing effect is considered to be accompanied by a fire-retardant effect (the thermal decomposition of the cellulose is modified). Fire retardants are impregnated into the wood in advance, whereas extinguishing agents are applied externally after the fire has started, so fire retardation can hardly have the same mechanism. This study concerns the first aspect, before thermal decomposition is extensive. Some good fire retardants are found to be effective when applied in this way, while others are useless. The effects are governed by the state of the agent. Test methods and results are reported. Author

N72-11109 National Lending Library for Science and Technology, Boston Spa (England).
**AN APPARATUS FOR THE RAPID ANALYSIS OF THE MOISTURE CONTENT OF OIL**
I. S. Liderman and L. V. Ulyanova 19 Aug. 1971 6 p ref Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel

(Moscow), v. 13, no. 2, 1968 p 57-58
(NLL-NSTIC-Trans-2333-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

An apparatus has been developed for the determination of the water content in oils. The apparatus works on the principle of transformation of the aggregate state of moisture, with intermediate reactions of water vapor with calcium hydride and subsequent measurement of the concentration of hydrogen by means of a thermal-conductivity detector. Author

N72-11110 National Lending Library for Science and Technology, Boston Spa (England).
**EVIDENCE OF A NEW PHASE INDUCED BY SPARK EROSION TREATMENT OF COBALT**
E. Krainer et al 19 Aug. 1971 12 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 61, Jan. 1970 p 350-354
(NLL-CE-Trans-5539-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

X-ray investigations of surfaces of technically pure cobalt which had been treated by spark erosion, have yielded a third modification which is stable at high temperatures and which had been conjectured from dilatometric measurements. The formation of this phase by spark erosion or by treatment with a plasma jet is reproducible at any time. The diffractometer diagrams can be indexed in terms of a hexagonal lattice and indicate a structure very similar to D 10 sub 2, Fe3Th7. The space group P6 sub 3 mc, C4 sub 6v, 186 and the parameters a = 8.288 A, c = 10.642 A, c/a = 1.272 are suggested for the new high temperature modification of cobalt. Author

N72-11111*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**TOPICS IN ATOMIC HYDROGEN STANDARD RESEARCH AND APPLICATIONS**
Harry E. Peters Oct. 1971 37 p
(NASA-TM-X-65732; X-524-71-408) Avail: NTIS CSCL 07D

Hydrogen maser based frequency and time standards have been in continuous use at NASA tracking stations since February 1970, while laboratory work at Goddard has continued in the further development and improvement of hydrogen masers. Concurrently, experimental work has been in progress with a new frequency standard based upon the hydrogen atom using the molecular beam magnetic resonance method. Much of the hydrogen maser technology is directly applicable to the new hydrogen beam standard, and calculations based upon realistic data indicate that the accuracy potential of the hydrogen atomic beam exceeds that of either the cesium beam tube or the hydrogen maser, possibly by several orders of magnitude. In addition, with successful development, the hydrogen beam standard will have several other performance advantages over other devices, particularly exceptional stability and long continuous operating life. Experimental work with a new laboratory hydrogen beam device has recently resulted in the first resonance transition curves, measurements of relative state populations, beam intensities, etc. The most important aspects of both the hydrogen maser and the hydrogen beam work are covered.
Author

N72-11112*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A MEASUREMENT OF THE FAST LUMINESCENT DECAY TIME OF P-15 PHOSPHOR**
John F. Sutton Sep. 1971 6 p refs Submitted for publication
(NASA-TM-X-65738; X-325-71-399) Avail: NTIS CSCL 07B

During the development of a delayed coincidence apparatus for the study of atomic decays, the need arose for a bright, fast, and inexpensive light source with known decay characteristics. A sample of P-15 phosphor was obtained for use as a calibration light source. A short pulse duration was employed to preferentially excite the short lifetime components relative to the longer-lived ones. The computer analysis revealed that the raw MCA decay curve data could be described well by a sum of three exponentials with decay times of about 88 nsec, about 6.5 nsec, and 1.04 + or - 2%. Author

N72-11113*# Techtran Corp., Glen Burnie, Md.
**STUDIES ON SYNTHESIS AND UTILIZATION OF FORMOSE. PART 2: CHROMATOGRAPHIC FRACTIONATION AND IDENTIFICATION OF FORMOSE SUGAR [HORUMOSE NO GOSEI TO RIYO (DAI 2 HO). HORUMOSU NO BUNBETSU OYOBI TOSOSEI NI TSUITE]**
Takashi Mizuno, Masakatsu Asai, Akira Misaki, and Yoshinobu Fujihara Washington NASA Nov. 1971 12 p refs Transl. into ENGLISH from J. of Agr. Chem. of Japan, v. 45, no. 7, 1971 p 344-350
(Contract NASw-2037)
(NASA-TT-F-14004) Avail: NTIS CSCL 07C

The sugar composition of formose, (monosaccharide mixture produced from the dilute formaldehyde aqueous solution at the yellowing point in the presence of calcium hydroxide) was investigated. Various methods of chromatography were used including paper chromatography of formose, thin layer chromatography of formose and its phenyl osazone derivative, gas-liquid chromatography of alditol acetate and trimethylsilyl derivatives of formose, and liquid-solid chromatography (sugar-autoanalyzer) of formose sugar. It was a found that formose was a mixture of monosaccharides of various carbon number (aldose and ketose). Hexose was the major component and pentose was the second. Triose, tetrose and heptose were the minor components. The following DL-racemic sugars were detected: glycerose and dioxyacetone as triose; erythrose and threose as tetrose; arabinose and xylose as pentose; and mannose, galactose, glucose, gulose, fructose and sorbose as hexose. A number of other pending spots or peaks were found on chromatographic patterns of formose. Author

N72-11114# Texas Univ., Austin. Dept. of Chemistry.
**UNUSUAL OXIDATION STATES OF TRANSITIONAL ELEMENTS Progress Report**
George W. Watt 1 Jun. 1971 14 p refs
(Contract AT(40-1)-1639)
(ORO-1639-20) Avail: NTIS

Complexes of the type PtL4I2, where L = pyridine, 3-picoline, 4-picoline, 4-ethylpyridine, and 3,5-lutidine, were synthesized and completely characterized. Pyrolysis of these relatively unstable complexes by both thermogravimetric analysis and differential thermal analysis is shown to provide the corresponding complexes of the type PtL2I2, which are only difficultly obtainable by other methods. That all of these products are the trans isomers is shown by a strong singlet absorption in the infrared spectrum between 176 and 196/cm. Study was continued of polyfunctional ligands, their deprotonation while in the coordination sphere of transitional metal ions, and reactions of the resulting deprotonated species. A detailed study was made of complexes of H2NCH2CH2NHCH2CH2OH. This should be a versatile ligand since it contains three coordination sites of markedly different basicities. Eighteen complexes of Pd(II), and Pt(IV) were synthesized, characterized, and studied in detail. The latter two were included to assess the effect of the oxidation state of Pt in the complexes. Author

N72-11115# Iowa State Univ. of Science and Technology, Ames.
**NUCLEOPHILIC ATTACK ON COORDINATED ISOCYANIDE AND CARBON MONOXIDE IN CATIONIC IRON COMPLEXES M.S. Thesis - Nov. 1970**
Linda Sue McDowell Charley Jun. 1971 34 p refs
(Contract W-7405-eng-82)
(IS-T-453) Avail: NTIS

An investigation was undertaken to determine if coordinated arylisocyanide ligands react like CO ligands in cationic iron complexes. Reactions of the cation, (pi-C5H5) (p-CH3OC6H4NC) 3Fe(+), were compared to those of cyclopentadienyliron tricarbonyl cation (pi-C5H5) (CO)3Fe(+). NMR studies indicate that the product exists as two isomers; these are due to

restricted rotation around the C-N bond of the amidinium group. Infrared studies indicate that the ethylamine and butylamine also react the same way. Similar studies show that ammonia and dimethylamine do not react. All attempts to displace an isocyanide group, p-CH3O C6H4NC, with other ligands Cl(-), Br,(-), I(-), and CN(-) failed. The mode of the reaction (pi-C5H5)Fe(CO)3(+) + NCO(-) yields (pi-C5H5)Fe (CO)2(NCO) + CO was also investigated. Results indicate the reaction takes place by substitution of a CO ligand by the NCO(-) ligand. The exchange reaction for (pi-C5H5)Fe(CO)2(NCO) is also examined.
Author

N72-11116# Oak Ridge National Lab., Tenn.
**ELECTROCHEMISTRY OF URANIUM AND URANIUM ALLOYS IN AQUEOUS SOLUTIONS**
G. H. Jenks Jul. 1971 149 p refs
(Contract W-7405-eng-26)
(ORNL-4651) Avail: NTIS

Certain aspects of the corrosion of uranium and uranium alloys were investigated as part of an effort to understand and control the corrosion of these materials in aqueous solutions at normal ambient temperatures. Part of the work consisted of experimental electrochemical studies of corrosion of uranium and of the alloy U-7.5 Nb-2.5 Zr at 25 C. The principal objective was providing an outline of the electrochemistry of these materials in the absence of aggressive anions. The solutions were primarily 0.1M K2SO4 at pH 5 to 10 and 0.1 and 1N H2SO4. A few pitting experiments were made with the alloy in solutions containing chloride in addition to 0.1M K2SO4 and in solutions of 0.1N HCl and 0.1N KCl, pH 8.7. Gas atmospheres employed were: 4H2:96Ar, Ar, 20 O2:80Ar. The potentials investigated ranged from < -1v to 5v vs SCE. Most of the polarizations were carried out potentiostatically but some were conducted galvanostatically. In either case current or potential values were recorded when judged to be within 5 to 10% of the steady state value. Reviews and analyses of literature information pertaining to the electrochemistry of uranium corrosion in aqueous environments below 100 C and pertaining to certain electrochemical aspects of pitting, crevice corrosion, and stress corrosion cracking are presented.
Author (NSA)

N72-11117# Iowa State Univ. of Science and Technology, Ames.
**BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR 1969 COMPILED BY A COMPUTER METHOD**
J. Capellen, H. J. Svec, J. R. Jordan, and R. Sun, (comps.) Jun. 1971 766 p refs
(Contract W-7405-eng-82)
(IS-2356) Avail: NTIS HC $9.00/MF $0.95

The year 1969 is covered and 7611 articles of interest to mass spectroscopists are listed. The report consists of three sections; a bibliography section, an author index section, and a keyword-out-of-context index (KWOC Index) section. The bibliography section lists the authors, the title, and the source for each article. The author index lists the authors' names and the reference numbers of their articles. The KWOC Index lists the keywords, the reference numbers of the articles in which the keyword appears, and the first 100 characters of the title.
Author (NSA)

N72-11118# California Univ., Berkeley. Lawrence Radiation Lab.
**MASS TRANSFER COEFFICIENTS AND INTERFACIAL AREA FOR GAS ABSORPTION BY AGITATED AQUEOUS ELECTROLYTE SOLUTIONS Ph.D. Thesis**
Campbell W. Robinson and Charles R. Wicke Apr. 1971 278 p refs
(Contract W-7405-eng-48)
(UCRL-20472) Avail: NTIS

In order to design or optimize the operation of stirred-tank gas absorbers, it is necessary to be able to characterize the oxygen mass transfer capabilities in terms of the physicochemical properties of the aqueous phase, the agitation power input, and the aeration rate. The oxygen mass transfer capability of a particular tank can be described in terms of the overall volumetric mass transfer coefficient, K sub L4a. A new simultaneous measuring technique involving concurrent chemical absorption of carbon dioxide and desorption of oxygen is developed for separately evaluating the liquid-phase oxygen mass transfer coefficient, K sub L4, and the specific interfacial area, a. Results from three different non-viscous aqueous electrolyte solutions show that at high agitation power input levels, such that the average gas bubble diameter is between 0.02 and 0.25 cm, K sub L4 decreases with increasing P sub G/V sub L.
Author (NSA)

N72-11119# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
**SPECIFICATION OF GAS CHROMATOGRAPHIC BEHAVIOR USING KOVATS INDICES AND ROHRSCHNEIDER CONSTANTS**
L. J. Lorenz and L. B. Rogers [1970] 43 p refs
(Contract AT(11-1)-1222)
(COO-1222-49) Avail: NTIS

The effects of sample size, nature of the liquid phase, and the existence of mixed separation mechanisms upon Kovats indices have been examined. The use of pure, discrete polymeric entities as stationary liquids has been examined as a better means of specifying stationary liquids. A set of low molecular weight polyethylene glycol species have been characterized as stationary liquids using the Rohrschneider system. Author (NSA)

N72-11120# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
**STERIC-EXCLUSION CHROMATOGRAPHY AT PRESSURES UP TO 3500 KG/CM SQUARE**
B. A. Bidlingmeyer and L. B. Rogers [1971] 9 p refs
(Contract AT(11-1)-1222)
(COO-1222-48) Avail: NTIS

High pressure steric-exclusion chromatography using rigid porous glass beads permitted the direct examination of pressure effects on the apparent size of bovine plasma albumin. The results are compared with those of another report which used a different technique to study the same protein under pressure.
Author (NSA)

N72-11121# California Univ., Livermore. Lawrence Radiation Lab.
**EXPERIMENTAL SYSTEM FOR DETERMINING NITROGEN OXIDES IN AIR**
Lester P. Rigdon and Richard W. Crawford 15 Jun. 1971 16 p refs
(Contract W-7405-eng-48)
(UCRL-51057) Avail: NTIS

An apparatus to study how effectively Hochheiser's and Saltzman's scrubbing solutions remove NO and NO2 from air is described. The apparatus includes a dynamic gas-calibration system that is designed to deliver from 1.5 to 1500 ng/min of NO and/or NO2. The gas reacts in either or both of two static scrubbers, then passes into a scrubbing coil for dynamic colorimetric analysis. The efficiency with which the above scrubbing solutions remove NO and/or NO2 under various conditions is examined. Preliminary studies with XeO3 and OsO4 in basic solutions indicate that strong oxidants can markedly improve the efficiency of Hochheiser-like solutions.
Author

N72-11122# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
**EFFECT OF AN ELECTRIC FIELD ON GAS CHROMATOGRAPHIC RETENTIONS BY LIQUID CRYSTALS**
Paul J. Taylor, Robert A. Culp, C. H. Lochmueller, L. B. Rogers, and Edward M. Barrall, II (IBM, San Jose, Calif.) [1970] 22 p refs
(Contract AT(11-1)-1222)
(COO-1222-47) Avail: NTIS

Reversible changes in gas-chromatographic peak shape and retention time were produced by applying an electric field across a capillary column that employed a liquid crystal as a stationary

phase. In general, applied potentials caused peaks to be retained longer and to be more nearly symmetrical in shape. The behavior of a variety of substances has been studied over a range of temperatures. Author (NSA)

N72-11123# Scientific Translation Service, Ann Arbor, Mich.
**PHASE EQUILIBRIA IN THE SYSTEMS ThO2-UO(2 PLUS x), AND NpO2-UO(2 PLUS x)**
Robert Paul [1971] 71 p refs Transl. into ENGLISH from German report KFK-1297 Prepared for ORNL Sponsored by AEC
(ORNL-tr-2483; KFK-1297) Avail: NTIS

The study of the phase diagram of the ternary system Th-U-O for the region ThO2-UO2-U3O8 between 1100 and 1550 C was undertaken by means of chemical analysis and X-ray investigations, as well as metallographic and spectroscopic techniques. Up to 1100 C a two phase region consisting of orthorhombic beta-U3O8 and cubic U4O9 was obtained. Above 1100 C the two phase region (beta-U3O8 and M4O9) extended from pure beta-U3O8 at 1550 C up to 36 mole% ThO2, at 1250 C up to 43 mole% ThO2. These phases were followed by the MO(2+x) phase over the whole range. The quasibinary systems MO2-UO(2+x) showed significant similarities.
Author (NSA)

N72-11124# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
**INTERNAL RAREFIED GAS FLOWS WITH BACKSCATTERING. PART 1: THE BACKSCATTERING BOUNDARY CONDITION AND FREE MOLECULE FLOW IN A LONG CAPILLARY**
A. S. Berman 16 Jun. 1971 18 p refs
(Contract W-7405-eng-26)
(K-1798-Pt-1) Avail: NTIS

A boundary condition designed to simulate the scattering of gas at a real randomly rough surface is proposed to replaced the usual assumption of diffuse scattering. A fraction 1 - alpha of incident molecules are assumed to be scattered back along their incident paths while a fraction alpha are scattered diffusely. For free molecule flow in a long capillary the modified boundary condition does not affect the gas density or collision density distribution along the capillary. The molecular flux in the capillary is reduced by the same fraction at each radial position, and the molecular flow through the capillary is reduced by an amount alpha/(2 - alpha). Author (NSA)

N72-11125# Scientific Translation Service, Ann Arbor, Mich.
**APPROXIMATION FOR THE EVALUATION OF INTEGRAL ABSORPTION MEASUREMENTS**
J. W. Dreyer, H. W. Patz, and D. Perner Aug. 1971 23 p refs Transl. into ENGLISH from the German Report Prepared for Argonne Natl. Lab.
(ANL-Trans-897) Avail: NTIS

The approximation of absorption spectra by a step function is a simple possibility for the evaluation of kinetic measurements. The method is independent of the shape of the spectrum and is applicable to low and moderate optical densities. The correction data result from a measurement of the integral transmission with the single (J/J sub o) and double optical pathlength in the absorber. The quantitative determination of the maximum optical density by means of this method depends on the line shape. The appropriate definition curves are given for Gaussian and dispersion structures of the absorption lines. Author (NSA)

N72-11126# Northwestern Univ., Evanston, Ill.
**FRAGMENTATION OF SMALL INORGANIC MOLECULES: HALIDES AND PSEUDOHALIDES**
Fred E. Stafford [1971] 4 p
(Contract AT(11-1)-1147)
(COO-1147-40; CONF-710518-1) Avail: NTIS

The initial ionization process and the probability of distribution over the various hypersurfaces representing the ionized states were studied. It is expected that a parent ion with a very weak bond is less likely either to be formed, or to hold together long enough for observation, hence removal of an electron from a strongly bonding orbital is likely to cause fragmentation. Removal of a nonbonding electron or an electron from a double bond is not expected to result in extensive fragmentation. The extent to which the method of chemical extrapolation is useful is examined. Correlation of fragmentation patterns with the molecular orbital patterns as observed by photoelectron spectroscopy is discussed.
Author (NSA)

N72-11127# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
**SELF-DIFFUSION IN LIQUID INDIUM**
M. Hsieh and R. A. Swalin [1971] 4 p refs
(Contract AT(11-1)-841)
(COO-841-21) Avail: NTIS

Self-diffusion in liquid indium was investigated over a limited temperature range. A small amount of radioactive indium 144m was placed in the bottom of a 7 cm capillary tube, and the rest of the tube was filled with inactive indium metal under vacuum. After diffusion annealing, the capillaries were cut into small sections, and the diffusion coefficients were determined. It was observed that the data lie along the line determined by Lodding and show no evidence of wall effect. F.O.S.

N72-11128# Iowa State Univ. of Science and Technology, Ames.
**STABILITIES OF SOME RARE-EARTH MALONATO CHELATE SPECIES IN AQUEOUS AND METHYL ALCOHOL SOLUTION Ph.D. Thesis**
Douglas Kiester Johnson Jul. 1971 163 p refs
(Contract W-7405-eng-82)
(IS-T-474) Avail: NTIS

The stepwise formation constants of the lanthanide chelate species of the dimethylmalonate, 1,1-cyclobutanedicarboxylate and 1,1-cyclopentanedicarboxylate ligands were determined in aqueous solution at 25 degrees centigrade and 0.10 molar ionic strength, using KNO3 as the supporting electrolyte. The stepwise formation constants of the terbium-1,1-cyclobutanedicarboxylate and the terbium-alpha-hydroxyisobutyrate chelate species in methyl alcohol solution were determined at 25 degrees centrigrade and 0.02 molar ionic strength, using LiCl as the supporting electrolyte. A potentiometric method was used to determine the formation constants in both solvents. It was necessary to determine the extent of ion pair formation for those electrolytes involved in the formation constant measurements in methanol. The ion pair dissociation constants were obtained from conductance data. The free activity coefficients were determined as a function of ionic strength by a potentiometric method.
Author

N72-11129# Bonn Univ. (West Germany). Inst. for Physical Chemistry.
**SIMULATION OF PHYSICAL-CHEMICAL PROCESSES IN THE UPPER ATMOSPHERE. PART 5: REACTIONS WITH ATOMIC NITROGEN**
K. H. Becker, W. Groth, and D. Kley Nov. 1969 35 p refs In GERMAN Sponsored jointly by Bundesmin. fuer Bildung und Wiss. and Nordrhein-Westfael. Landesamt fuer Forsch.
(SHA/5) Avail: NTIS

Reactions of atomic nitrogen with oxygen, hydrogen and ammonia under high altitude conditions were simulated in a chemical reactor. The velocity constant for the reaction between nitrogen and oxygen, producing nitrogen oxide, is investigated under low varying pressure. The velocity constant for nitrogen atom recombination is determined at low pressure and in the presence of additional gases such as carbon dioxide, argon, nitrogen, and helium. Finally the velocity constant for nitrogen atom recombination in the presence of hydrogen and ammonia is investigated. ESRO

N72-11130# Explosives Research and Development Establishment, Waltham Abbey (England).

**THE MASS SPECTROMETRY OF SUBSTITUTED OCTADIENES**

R. T. M. Fraser, N. C. Paul, D. H. Richards, and N. F. Scilly Jul. 1970 16 p refs

(ERDE-TR-33) Avail: NTIS

The relative intensities of the principal ions from fifteen substituted octadienes were determined. In general, parent peaks are small, and the importance of allylic fission decreases as the molecular weight increases, but the spectra of the 2,6-, 1,6- and 1,7-isomers are sufficiently different to be used to determine relative proportions in mixtures. Author (ESRO)

N72-11131# National Physical Lab., Teddington (England). Div. of Chemical Standards.

**THE DETERMINATION OF TRACE AMOUNTS OF TITANIUM IN LITHIUM FLUORIDE POWDER BY X-RAY EMISSION SPECTROSCOPY**

Joyce M. Griffiths and H. R. Whitehead Jul. 1971 21 p refs

(NPL-DCS-12) Avail: NTIS

Titanium was determined in lithium fluoride powders in the concentration range from 1 to 30 ppm by an X-ray fluorescence method which includes correction for background signal. The results show satisfactory relations between the titanium content and certain physical properties which serve to check the validity of the analyses. Author (ESRO)

N72-11132# Royal Swedish Academy of Engineering Sciences, Stockholm.

**ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS FORMED IN ELASTOMERS BY ULTRAVIOLET IRRADIATION**

Peter Carstensen (Roy. Inst. of Tech.) 1970 29 p refs *Its* Acta Polytech. Scand., Chem. including Met. Ser. 97

(PB-200313; APS-CH-97) Avail: NTIS CSCL 07E

The processes occuring between the absorption of a photon and bond scission are considered in light of their importance in determining the overall course of a degradation process under the influence of ultraviolet light. From the radicals identified in previous research it would at first seem possible to classify poly (isobutene) as cross-linking because no chain scission radicals are observed, and the other polymers as tending to degrade because only chain scission radicals are observed, however, that the radicals identified in this study are only those which were stable enough to be observed by means of ESR spectroscopy. The results from past research are summarized and discussed in relation to bond energies, to end products formed by both high energy and UV radiation, and to the results from other polymers. Author (GRA)

N72-11133# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.

**MOLECULAR PHENOMENA IN H2O SYSTEMS. 1: A MOLECULAR INTERPRETATION OF THE PHASE DIAGRAM OF ICE**

Arthur R. VonHippel and E. F. Farrall Apr. 1971 27 p refs

(Contract N00014-67-A-0204-0053; NR Proj. 105-632)

(AD-724731; TR-8) Avail: NTIS CSCL 20/2

The study gives a molecular interpretation of the phase diagram of ice by showing how the H2O molecules shift and relink in the transformations between the various ice phases. Author (GRA)

N72-11134# University of Southern Calif., Los Angeles. Dept. of Chemistry.

**PHYSICAL ADSORPTION OF VAPORS Final Scientific Report, Jun. 1966 - Dec. 1970**

Arthur W. Adamson 27 May 1971 10 p refs

(Grant AF-AFOSR-1097-66; AF Proj. 9760)

(AD-724740; AFOSR-71-1624TR) Avail: NTIS CSCL 07/4

The results of several series of investigations are reported. The nature of the ice-vapor interface has been studied at 77K, using nitrogen, argon, and carbon monoxide as adsorbates; at -80C, with ethane and with carbon dioxide; and at -30C to -40C, using n-pentane and n-hexane. At low temperatures, ice-surface is inert and non-polar; at higher temperatures bulk phase reaction may occur with small adsorbate molecules to form the ice clathrate compound; and with larger molecules, surface restructuring may occur. Other molecular solids were studied at 77K, and behave similarly to ice; the adsorbent-adsorbate dispersion interaction is very weak in these systems. Adsorption at the ice-liquid n-hexane interface has been studied. Contact angle data have been obtained for carbon disulfide on ice as a function of temperature. It is proposed that solid-liquid interfaces be classed as A or B in type, depending on whether restructuring of the solid surface occurs. An adsorption model has been developed relating adsorption isotherms to contact angle and spreading behavior. Author (GRA)

N72-11135# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.

**FORMATION AND UTILIZATION OF STABLE LIPID MEMBRANES WITH MULTIPLE RESISTANCE STATES Interim Technical Report, Jul. 1969 - Jun. 1970**

Ross C. Bean Wright-Patterson AFB, Ohio. AMRL Apr. 1971 55 p refs

(Contract F33615-69-C-1729; Proj. AF-7232)

(AD-725783; U-4898; AMRL-TR-70-108) Avail: NTIS CSCL 07/4

Studies have been initiated on development of stable membranes with nonlinear resistance characteristics related to those observed in experimental lipid bilayer membranes treated with EIM (Excitability Inducing Material). Further studies on the negative resistance of the EIM lipid bilayers showed that EIM penetrates the membrane to form ion conductive channels with two or more conductance states. The probability that each channel may exist in open or closed states is affected by the potential across the channel so the potential dependent resistance transitions in the EIM membrane are reflections of change in relative populations in open or closed states. Definite evidence has been obtained, however, that each channel may exist in certain intermediate conductance states in addition to fully open or fully closed states. Studies of resistance characteristics of thin polymeric membranes have revealed nonlinear characteristics in film cast upon glass or aqueous surfaces. Films, 1-3 micrometers thick prepared from ethyl cellulose, polycarbonate, or polyamide, or combinations of these materials with each other or with lipids may have significant nonlinear resistances including partial rectification characteristics. Sensors for air-borne organic vapors, based upon membrane interface relations, have been tested. Significant sensitivities to a number of organic compounds were obtained. Author (GRA)

N72-11136# IIT Research Inst., Chicago, Ill.

**THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Final Scientific Report**

Alan Snelson May 1971 94 p refs

(Contract AF 49(638)-1718; AF Proj. 9750-01)

(AD-725766; AFOSR-71-1381TR) Avail: NTIS CSCL 07/4

The matrix isolation technique was used to obtain the infrared spectra (4000-200/cm) of the high temperature species, AlF2, Al2F6, AlF, BeCl2, BeBr2, BeI2, 6LiNaF2, LiNaF2, 6LiAlF4, 7LiAlF4, and NaAlF4. A new method for determining heats of sublimation of high temperature materials was developed using the matrix isolation technique. The method was tested by determining the heat of sublimation of AlF3, and then applied to the lithium fluoride vapor system. Heats of formation were obtained for LiF(g), Li2F2(g-linear) and Li2F2(g-rhombohedral). The matrix technique was further extended to the analysis of unstable radical intermediates in pyrolysis reactions. The infrared spectra of the species CH3, CD3, CF3, and CF2 were obtained using this new approach. Author (GRA)

N72-11137# Sussex Univ., Brighton (England).
**INORGANIC MASS SPECTROMETRY AND THERMOCHEMISTRY RELATED TO FUELS, STRUCTURAL MATERIALS AND POLYMERS Final Scientific Report, 1 Oct. 1966 - 30 Sep. 1970**
Michael F. Lappert and J. B. Pedley May 1971 72 p refs
(Contract F61052-67-C-0005; AF Proj. 9538)
(AD-725781; AFOSR-71-1846TR-Rev) Avail: NTIS CSCL 07/3

Measurements of the heats of hydrolysis of about 20 compounds of the type Me3M-X (Me = CH3; M = Si, Ge, or Sn; and X = Cl, Br, I, OMe, SC4H9-n, NMe2, NM3(MMe3), N(MMe3)2, and NH(MMe3)), and the heats of combustion of Et4Si, Me6Si2, and (Me3Si)2O gave standard heats of formation and thermochemical bond energy terms. Computer analysis of thermochemical data has been carried out and a thermochemical center has been established to provide computer-processed, mutually-consistent and updated standard heats of formation. Measurements of 1st ionization potentials of all the 20 boron halides BXX'X double prime mass spectrometrically and of other simple boron compounds, and quantum mechanical analysis of the results has been completed. Measurements of mass spectrometric appearance potentials for Group IV derivatives and computation of M-M and M-M' bond dissociation energies has been carried out. Measurements of 11B nuclear magnetic spectra for BXX'X double prime/BYY'Y double prime systems provided equilibrium constants for redistribution and 11B/19F coupling constants. H n.m.r. spectra of BN compounds have provided BN rotational energy barrier data. Measurements of photon-excitation photoelectron spectra for simple compounds of BXX'X double prime provided the energies of the four or five highest occupied orbital energy levels and their assignments according to symmetry and bonding. Measurements of 119Sn Mossbauer spectra and heteronuclear double resonance and 'Indor' spectra of many organotin compounds have been carried out. Author (GRA)

N72-11138# Air Force Systems Command, Edwards AFB, Calif.
**THE KINETICS OF ClF DISSOCIATION BEHIND INCIDENT SHOCK WAVES Technical Report, Nov. 1969 - Dec. 1970**
J. A. Blauer, W. C. Solomon, and V. S. Engleman Jul. 1971 35 p refs
(AF Proj. 314803BCB)
(AD-725046; AFRPL-TR-71-61) Avail: NTIS CSCL 07/4

Two-body emission from chlorine atoms has been used to follow the thermal decomposition of ClF occurring behind incident shock waves in the temperature range of 1700-2200 K. The initial reaction rates were interpreted in terms of the bimolecular rate constant for the reaction ClF + M = Cl + F + M and may be expressed in the form k sub d = (10 to the 14.6 + or - 0.3 power) exp(-61,300 + or - 3000/RT) cc/mole-sec. If the competing exchange reaction Cl + ClF = Cl2 + F is very fast, then the rate expression for step (1) becomes k sub d = (10 to the 14.5 power) exp(-57,400/Rt) cc/mole-sec. The latter value for k sub d is in better agreement with all of the available data. Author GRA

N72-11696# Institut Francais de Petrole, Grenoble (France).
**SYNTHESIS AND PROPERTIES OF ESTERS OF TETRAMETHYL-2,2-7,7 OCTANE DIOL-1,8 [LES ESTERS DU TETRA METHYL-2,2-7,7 OCTANE DIOL-1,8 SYNTHESE ET PROPRIETES]**
P. Bedegue, B. Sillion, and G. DeGaudemaris *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs In FRENCH (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

# 07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N72-11139 Catholic Univ. of America, Washington, D.C.
**A PASSIVE ARRAY-PROCESSOR FOR TRACKING AND SIGNAL EXTRACTION Ph.D. Thesis**
Carol Ann E. Roberts 1970 159 p
Avail: Univ. Microfilms Order No. 70-19557

The passive array-processor considered employs techniques that were developed for monopulse radars to perform the tasks of target detection and tracking; extracting the target signal from a noisy background is accomplished using an adaptive multi-channel filter. A complete monopulse processor that is easy to implement digitally is described. The variance of the bearing estimator for this process is derived and compared with the variance obtained from computer simulations. The process offers a very powerful bearing determination technique to be used with passive linear arrays. Once the first estimate of target bearing has been made, the bearing estimator can be used in a feedback process to keep track of a moving target by automatically adjusting a set of spatial correction filters. Dissert. Abstr.

N72-11140 Tennessee Univ., Knoxville.
**THE DEVELOPMENT OF A TRIGONOMETRIC THEORY TO APPROXIMATE THE CURRENT DISTRIBUTION ON ISOLATED AND COUPLED THIN CYINDRICAL CENTRAL-DRIVEN DIPOLE ANTENNAS IMMERSED IN VACUUM AND HOMOGENEOUS ISOTROPIC DISSIPATIVE MEDIA Ph.D Thesis**
Curtis Albert Siller 1969 224 p
Avail: Univ. Microfilms Order No. 70-17846

The antenna integral equation is derived from the vector potential formulated in terms of the tangential electric field and the magnetic field over the cylindrical antenna surface. This derivation is appropriate for both symmetrically and asymmetrically coupled antennas and expresses the constant in Hallen's integral equation in terms of the electric field off the end of the antenna. A transfer function concept is developed which shows that the standard approximation made in the kernel of the integral equation precludes an exact solution to the equation. The approximate current distribution is expanded in a series which automatically satisfies the boundary conditions on the antenna current at the ends of the dipole. The electric field is formulated in a manner which permits the simple computation of axially-directed tangential electric fields. The analysis of the dipole antenna is extended to two coupled parallel elements and to an isolated dipole in a homogeneous, isotropic, dissipative medium of infinite extent. Dissert. Abstr.

N72-11141 Stanford Univ., Calif.
**SIGNAL PROCESSING FOR PARAMETER DETERMINATION WITH LINEAR ARRAYS Ph.D. Thesis**
Crawford Warick Scott 1970 130 p
Avail: Univ. Microfilms Order No. 70-18473

A concept of signal processing is developed to determine the frequency and direction of arrival of a plane wave at a localized receiving point. The system is not restricted at any instant to observation of a subset of the admissible signals through a priori estimates of the received signal; furthermore, no estimate of signal duration is necessary. Two or more linear arrays are used to sample the electromagnetic environment at the receiving point. The signal sets so acquired are combined to synthesize signals of known form from which data related to the parameters of interest are extracted. The knowledge of the form of these signals is used to select preferred data values for computational parameter determination. This method of

information management is important in that it supports the development of a measure of quality of the system performance. The measure of quality is in the form of two probability density functions that represent the most general measure of performance. Dissert. Abstr.

**N72-11142** Stanford Univ., Calif.
**INTERPRETATION OF VLF SIGNALS OBSERVED ON THE OGO-4 SATELLITE Ph.D. Thesis**
Rege Romeu Scarabucci 1970 169 p
Avail: Univ. Microfilms Order No. 70-18469

Very-low-frequency (VLF) signals observed with the polar orbiting OGO-4 satellite are presented and interpreted. The VLF signals originate in the air space below the ionosphere and cover the frequency range approximately 0.3 to approximately 30 kHz. The sources are lightning flashes and highpower VLF transmitters. The observations are compared with calculations based on a full-wave treatment of transmission through the lower ionosphere and a ray theory treatment in the upper ionosphere and in the magnetosphere. Several situations related to the propagation of VLF waves are considered. Included are the amplitude of the wave fields when OGO 4 is in the vicinity of VLF stations, two equatorial phenomena corresponding to propagation at low latitudes, and several phenomena observed at mid-high latitudes. The study also includes the differences between daytime and nighttime propagation. Dissert. Abstr.

**N72-11143** California Univ., Los Angeles.
**SIGNAL DESIGN FOR RANDOMLY TIME VARYING CHANNELS Ph.D. Thesis**
Gholan-Reza Askary Tourzan 1970 92 p
Avail: Univ. Microfilms Order No. 70-19907

This dissertation treats the problem of choosing the best signal waveform that provides the maximum probability of detection for the class of channels where the received waveform contains in addition to the usual ambient temperature limited (white Gaussian) noise, a clutter or reverberation component which can be expressed as the output of a randomly time varying linear filter with the transmitted signal as input. It considers the coherent and noncoherent radar signal design problem and the coherent bi-phase PCM communication problem and shows that if there is no restriction on either time duration or bandwidth of the signals to be used, then the clutter effect can be effectively removed. Nonlinear equations are obtained for the stationary points of the optimum filter signal-to-noise ratio and the matched filter signal-to-noise ratio with iterative procedures to reach these stationary points. These iterative procedures are then applied to the signal design problem of a spacecraft in the vicinity of the moon when the moon is regarded as a uniform rough rotating sphere. Dissert. Abstr.

**N72-11144** Pennsylvania State Univ., University Park.
**TRANSIENT ANALYSIS OF PLANAR SONAR ARRAYS Ph.D. Thesis**
Peter Richard Stepanishen 1969 301 p
Avail: Univ. Microfilms Order No. 70-19474

The investigations which are reported were concerned with the transient behavior of sctive sonar arrays. The main areas of the studies were: (1) The investigation of near and far field transient pressure phenomena resulting from specified spatial and temporal velocity distributions of an array of pistons, and (2) The investigation of the time-dependent velocities of transducers in an array resulting from a set of specified electrical inputs. The study of transient pressure phenomena was performed using a Green's function approach to obtain the solution of the associated boundary value problem. A time domain approach to the solution based on impulse response techniques was developed and shown to yield an increased physical understanding of both transient and steady-state pressure phenomena. Extension of the technique was then performed to permit the study of the time dependent self-radiation and mutual interaction forces between elements in an array for specified velocity distributions. Techniques were also developed to obtain the self and mutual radiation impedance coefficients using the time domain approach. A comparison of the steady-state results with classical results showed excellent agreement. Dissert. Abstr.

**N72-11145** California Univ., Berkeley.
**ON THE INFORMATION CAPACITY OF PEAK AND AVERAGE POWER CONSTRAINED GAUSSIAN CHANNELS Ph.D. Thesis**
Joel Gorham Smith 1969 117 p refs
Avail: Univ. Microfilms Order No. 70-17659

The amplitude-constrained capacity of a scalar Gaussian channel is shown to be achieved by a unique discrete random variable taking on a finite number of values. Necessary and sufficient conditions for the distribution of this random variable are obtained. These conditions permit determination of the random variable and capacity as a function of the constraint value. Extensions to non-Gaussian channels are discussed. The capacity of the same Gaussian channel subject additionally to a non-trivial variance constraint is also shown to be achieved by a unique discrete random variable taking on a finite number of values. Likewise capacity is determined as a function of both amplitude and variance constraint values. Upper and lower bounds on the peak-power and peak-and-average-power constrained capacities of bandlimited Gaussian white noise channels are obtained. The peak-power constrained and average-power constrained capacities of Gaussian white channel of infinite bandwidth are shown to be equal. Dissert. Abstr.

**N72-11146** British Broadcasting Corp., Kingswood (England). Engineering Div.
**PULSE CODE MODULATION FOR HIGH QUALITY SIGNAL DISTRIBUTION: SIMULATION OF AN ADVANCED FORM OF ERROR PROTECTION**
M. G. Croll 1971 6 p refs
(BBC-1971/37; UDC-534.86:621.376.56) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

An advanced form of error protection which is applicable to multiplexed sound signals and can be used to reduce the audible effect of errors introduced when the digital signal is transmitted through a communications system is described. The method of error detection, in which single-bit parity checks are made of both the words and digits, enables single-bit errors within a frame to be corrected digitally. Most errors affecting more than one bit can be detected but because the digits affected cannot be uniquely located, concealment processes are applied to the erroneous words. An experimental simulation of the advanced system showed that when it was used in conjunction with an interpolator that conceals errors which are detected but not corrected, the subjective impairment of the sound signal would be just perceptible when the error rate is 1 in 1000 bits. Author

**N72-11147** World Meteorological Organization, Geneva (Switzerland).
**UTILIZATION OF METEOROLOGICAL RADAR FOR AERONAUTICS [L'UTILISATION DES RADARS METEOROLOGIQUES POUR L'AERONAUTIQUE]**
H. Treussart, W. B. Beckwith, S. G. Bigler, K. Otani, V. V. Kostarev, and R. Schwarz 1971 108 p refs In FRENCH; ENGLISH summary
(OMM-264-TP-148; UDC-551.501.81; NT-110) Copyright. Avail: Issuing Activity

The detection and identification of hail and turbulence associated with thunderstorms are discussed. The question of measuring the height of echoes observed by radar is presented. Echo height is an index of storm activity. The interpretation of echoes for different types of radar is considered. The data from weather radar depend not only on meteorological phenomena but also, to a great extent, on the characteristics of the radar. Processing and transmission of radar information is reviewed in great detail. Transmission of radar information to aircraft in flight is also considered a subject important for aviation. New techniques for radar observations are summarized. Author

N72-11148* Hughes Aircraft Co., Los Angeles, Calif.
**VIRTUAL WALL SLOT CIRCULARLY POLARIZED PLANAR ARRAY ANTENNA** Patent
Arthur F. Seaton, inventor (to NASA) Issued 10 Aug. 1971 11 p Filed 11 Aug. 1969 Sponsored by NASA Prepared for JPL Supersedes N70-12621 (08 - 02, p 245)
(NASA-Case-NPO-10301; US-Patent-3,599,216; US-Patent-Appl-SN-848810; US-Patent-Class-343-771; US-Patent-Class-343-853) Avail: US Patent Office CSCL 09F

A circularly polarized planar array antenna is provided by a multimode waveguide with alternately displaced transverse slots over virtual walls for one component, and conventional series or shunt slots between virtual walls for the other component of a circularly polarized beam. Actual walls are inserted in the place of virtual walls for unbalanced excitation of the array with a quarter-guide wavelength choke under each wall slot.
Official Gazette of the U.S. Patent Office

N72-11149* ITT Corp., Nutley, N.J.
**SATELLITE INTERLACE SYNCHRONIZATION SYSTEM** Patent
Irving A. Krause, James G. Dunn, Irving Lane Fletcher, Walter K. Allen, and John E. Miller, inventors (to NASA) Issued 13 Jul. 1971 27 p Filed 31 Jul. 1968 Sponsored by NASA
(NASA-Case-GSC-10390-1; US-Patent-3,593,138; US-Patent-Appl-SN-749121; US-Patent-Class-325-4; US-Patent-Class-325-39; US-Patent-Class-325-58; US-Patent-Class-343-5DP; US-Patent-Class-343-7.5; US-Patent-Class-343-179) Avail: US Patent Office CSCL 17B

A master station and a plurality of slave stations are described which use synchronization equipment to enable each of the stations to have access to a common repeater in a different time slot of a time division multiplex format at the repeater. The master station propagates a sync burst through the repeater. Each of the stations receives this sync burst from the repeater and adjusts the frequency of the timing signals to compensate for the Doppler shift experienced in the propagation path from each of the stations to the repeater so that the desired frequency of the timing signals is present in the repeater. Each of the slave stations also propagates different low power level, pseudo noise code ranging signal through the repeater back to itself which is used to adjust the phase of the timing signals digitally. Official Gazette of the U.S. Patent Office

N72-11150* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SYSTEM FOR CONTROLLING THE OPERATION OF A VARIABLE SIGNAL DEVICE** Patent
Richard Bauer Kolbly, inventor (to NASA) Issued 13 Jul. 1971 4 p Filed 26 Nov. 1969 Sponsored by NASA Supersedes N70-35628 (08 - 19, p 3498)
(NASA-Case-NPO-11064; US-Patent-3,593,180; US-Patent-Appl-SN-880248; US-Patent-Class-331-10; US-Patent-Class-331-7; US-Patent-Class-331-34; US-Patent-Class-331-66) Avail: US Patent Office CSCL 14B

A system for controlling the operation of a variable signal generator is described. The system includes an error generator which provides an output which varies as a function of the difference between the instantaneous output signal value of the variable signal generator and a reference signal value. A variable light source emits light of an intensity corresponding to the error signal level. An electrically isolated, light-dependent, control signal generator including a photoresistive voltage divider is disposed in optical communication with the light source. The control signal generator provides signals to the control terminal of the variable signal generator to regulate its operation.
Official Gazette of the U.S. Patent Office

N72-11151# Bochum Univ. (West Germany).
**ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN DIELECTRIC MIXED BODIES Ph.D. Thesis [UEBER DIE FORTPFLANZUNG ELEKTONAGNETISCHER WELLEN IN DIELEKTRISCHEN MISCHKOERPERN]**
Guenter Schulten 1970 118 p refs In GERMAN; ENGLISH summary
Avail: NTIS

Three different types of dielectric mixtures are investigated: the hole medium (a dielectric body provided with parallel holes), the plane-periodically stratified medium and the coaxially stratified medium. Results are compared with the known properties of a corresponding isotropic medium. It turns out that the inhomogeneous hole medium is astigmatic and that the field distribution is compressed in the direction of the electric-field vector. Plane-periodically stratified media are studied theoretically by means of matrices (Abeles). A model for describing the wave propagation in such a medium is introduced: the periodically stratified medium as a discontinuous transmission line. A coaxially stratified medium of finite diameter represents a cylindrical lens which has one focal line for ordinary rays but two focal lines for extraordinary rays (bifocal cylindrical lens). These theoretical results are experimentally verified. Author

N72-11152*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DEVELOPMENT AND TESTING OF THE S-BAND ANTENNA SUBSYSTEM FOR THE MARINER MARS 1971 SPACECRAFT**
Albert G. Brejcha 1 Nov. 1971 13 p ref
(Contract NAS7-100)
(NASA-CR-123357; JPL-TM-33-503) Avail: NTIS CSCL 17B

The Mariner Mars 1971 S-band antenna subsystem is used to transmit and receive S-band signals to and from the Deep Space Instrumentation Facility ground stations. The antenna subsystem consists of a low-gain antenna, a medium-gain antenna, a directional coupler, a high-gain antenna, and all transmission lines required to interconnect the antennas to the spacecraft radio frequency subsystem. The low-gain antenna is used to transmit signals during cruise and receive signals throughout the mission. The medium-gain antenna is coupled to the low-gain antenna via the directional coupler and is used to transmit and receive signals during Mars orbit insertion. The high-gain antenna is used to transmit high data rate signals primarily during Mars orbit. Author

N72-11153*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**RADIO FREQUENCY INTERFERENCE HANDBOOK**
Ralph E. Taylor, ed. Washington 1971 273 p refs
(NASA-SP-3067; LC-74-174579) Avail: NTIS CSCL 17B

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2. ELECTROMAGNETIC COMPATIBILITY DESIGN GUIDELINE FOR STADAN R. B. Cowdell, J. S. Hill, J. C. Senn, J. C. Shifman, and J. W. Skaggs (Genisco Tech. Corp., Wash., D. C.) p 107-198 refs (See N72-11155 02-07)
3. LIGHTNING PROTECTION PRACTICES APPLIED TO FIELD STATION INSTALLATIONS T. J. Blalock and E. R. Uhlig (GE Co., Pittsfield, Mass.) p 199-253 refs (See N72-11156 02-11)

N72-11154*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
**ELECTROMAGNETIC COMPATIBILITY FUNDAMENTALS APPLIED TO SPACECRAFT RADIO COMMUNICATION SYSTEMS**
F. Haber, M. Celebiler, and C. Weil-Malherbe *In* NASA. Goddard Space Flight Center Radio Freq. Interference Handbook 1971 p 1-106 refs (See N72-11153 02-07)
Avail: NTIS CSCL 17B

A design guide for minimizing electromagnetic interference in aerospace communication equipment for ground stations is presented. Specifically treated are the mechanisms of generating unwanted radio emissions that may affect station operations as

well as other communications services, the mechanisms by which sensitive receivers become susceptible to interference, means for reducing interference, standard methods of measurement, and the problems of site selection. The sources of interference are viewed primarily as originating from communications transmitters aboard spacecraft and aircraft, ground transmitters within and outside the ground stations, and other electrical sources on the ground that are not intended to radiate.
Author

N72-11155*# Genisco Technology Corp., Washington, D.C. Genistron Washington Facility.
**ELECTROMAGNETIC COMPATIBILITY DESIGN GUIDELINE FOR STADAN**
Robert B. Cowdell, James S. Hill, James C. Senn, Jerrald C. Shifman, and John W. Skaggs *In* NASA Goddard Space Flight Center Radio Freq. Interference Handbook 1971 p 107-198 refs (See N72-11153 02-07)
Avail: NTIS CSCL 17B

Procedures for achieving electromagnetic compatibility in electronic and electrical equipment for aerospace ground stations are investigated. The application of shielding theory to good design is treated and standards of good practice are outlined for bonding, grounding, wiring, and cabling. Some aspects of filter design are explained, and suggestions are given for the application of filters to electronic and electrical equipment. Author

N72-11156*# General Electric Co., Pittsfield, Mass. High Voltage Lab.
**LIGHTNING PROTECTION PRACTICES APPLIED TO FIELD STATION INSTALLATIONS** c11
Thomas J. Blalock and Edward R. Uhlig *In* NASA. Goddard Space Flight Center Radio Freq. Interference Handbook 1971 p 199-253 refs (See N72-11153 02-07)
Avail: NTIS CSCL 14B

Theoretical considerations of lightning phenomena and the effects of the magnetic, capacitive, and resistive components of lightning-induced voltages are discussed. A typical tracking station is analyzed from a lightning standpoint. Specific protective methods are discussed, including the implementation of high-surge-current voltage clippers for sensitive electrical and electronic circuits, grounding, counterpoises, and bonding. The safety of operating personnel is also treated as a prime consideration. Author

N72-11157# Joint Publications Research Service, Washington, D.C.
**SATELLITE COMMUNICATION LINE NETWORKS AND SYSTEMS**
A. P. Sivers 26 Oct. 1971 10 p Transl. into ENGLISH from the monograph "Osnovy Kosmicheskoy Radioelektroniki" Moscow, Izd-vo Sovetskoye Radio, 1969 p 174-182
(JPRS-54317) Avail: NTIS

A communication satellite system, based on superhigh frequency waves between many ground stations along a radio link, is described. The system provides duplex or simplex multichannel telephonic, telegraphic, and phototelegraphic communications as well as black-and-white and color television signal transmissions. On odd revolutions, the artificial satellite apogees ensure communication between any points in the U.S.S.R., Europe, and Asia over a period of nine hours, and on even revolutions communication between the European U.S.S.R. and Central and North America for three hours. G.G.

N72-11158# Joint Publications Research Service, Washington, D.C.
**DETERMINATION OF SIGNAL/CLUTTER RATIO**
A. M. Taraskin 1 Nov. 1971 11 p refs Transl. into ENGLISH from Izv. Vuzov SSSR, Radioelectron. (Kiev), v. 14, no. 8, 1971 p 852-860
(JPRS-54365; UDC-621.396.967) Avail: NTIS

A procedure for determining the signal/clutter ratio due to reflections on the output of the linear part of the receiver is reported. Considered is a radar system using pulsed emission without intrapulse modulation. An approximative method is used to optimize internal noise in a single short pulse by relating monotonic dependence with the quality indices of detection and measurement processes. G. G.

N72-11159*# Magnavox Co., Fort Wayne, Ind. Government Electronics Div.
**SURFACE ELASTIC WAVE DETECTORS** Final Report, 26 Jun. - 26 Oct. 1971
Ronald L. Lawson 26 Oct. 1971 83 p
(Contract NAS8-27800)
(NASA-CR-121026; ASW-345) Avail: NTIS CSCL 17B

The potential applications of acoustic surface wave technology to multiplex communication systems such as data-bus, are examined. The goals are primarily to characterize certain aspects of surface wave trapped delay lines, surface wave modulation techniques, and surface wave applications that are relevant to the evaluation of surface wave devices in multiplex systems. The results indicate that there is a potential for the application of surface wave technology in data-bus type systems.
E.H.W.

N72-11160*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**METHOD AND APPARATUS FOR SYNCHRONIZING A SINGLE CHANNEL DIGITAL COMMUNICATIONS SYSTEM Patent Application**
Lucien A. Couvillon, Jr., Christopher Carl, Richard M. Goldstein, Edward C. Posner, and Richard R. Green, inventors (to NASA) Filed 11 Sep. 1970 68 p
(Contract NAS7-100)
(NASA-Case-NPO-11302; US-Patent-Appl-SN-70967) Avail: NTIS CSCL 17B

A method and apparatus is described for synchronization of a received PCM communications signal, without requiring a separate synchronization channel. The received signal is digitally correlated with a reference signal, first with its unmodulated subcarrier and then with a bit sync code modulated subcarrier, in which the code sequence length is equal in duration to each data bit. NASA

N72-11161# Naval Underwater Systems Center, Newport, R.I.
**ENVELOPE CORRELATION OF UNDERSAMPLED DATA BY DIGITAL PROCESSING**
Benjamin F. Cron and Albert H. Nuttall 25 Mar. 1971 30 p
(AD-725112; NUSC-4065) Avail: NTIS CSCL 17/1

Digital computers can be used to obtain the complex envelope correlation of undersampled data. To obtain the complex envelope of the original process, a band of frequency easily shifted down to a center frequency of 0 Hz. A quantitative comparison of the theoretical and computed results shows that the digital method was accurate when employed for two specific examples of a sinc pulse and a linear FM pulse. Author (GRA)

N72-11162# Maryland Univ., College Park. Dept. of Electrical Engineering.
**THEORETICAL STUDY OF THE SYNCHRONOUS DEMODULATION PROBLEM FOR A WALSH WAVE RECEIVER**
Henning F. Harmuth and Thomas H. Frank Jun. 1971 90 p refs
(Grant AF-AFOSR-1971-70; AF Proj. 9768)
(AD-725755; R-71-04; AFOSR-71-1747TR) Avail: NTIS CSCL 17/2

It is well known that the usual frequency filters based on sine-cosine functions do not require synchronization. Furthermore, sinusoidal electromagnetic waves of different frequency can be separated in mobile communication without any synchronization between the various transmitters and receivers. It is widely believed that this is a result of certain shift invariant features of sinusoidal functions that do not exist for other functions. The

purpose of this report is to show by means of simple examples that there are infinitely many systems of functions on which one may base asynchronous filters and mobile radio communication. The difference in the usefulness of these systems of functions depends on the state of technology, no system is inherently better than others. Author (GRA)

N72-11163# Naval Research Lab., Washington, D.C.
**A STUDY OF THE FEASIBILITY OF USING 35 GHz AND/OR 94 GHz AS A MEANS OF IMPROVING LOW ANGLE TRACKING CAPABILITY**
Frank H. Thompson and Frank A. Kittredge May 1971 43 p refs
(NRL Proj. R02-24)
(AD-725108; NRL-MR-2249) Avail: NTIS CSCL 17/9

Millimeter-wave radar systems was analyzed to determine their low-angle tracking capability. The narrow beamwidths that can be obtained at these frequencies with antennas of reasonable size permit a target to be resolved in angle from its image. Because of the severe effects of tropospheric attenuation, the study was limited to two frequency bands, 35 and 94 GHz, which lie near the principal minima of the attenuation curve. Theoretical expressions for radar tracking accuracy, together with existing attenuation data, have been used to compare the performance of realizable 35-GHz (K sub a-band) and 94-GHz (W-band) radars with that of an existing 5280-MHz (C-band) radar. An antenna diameter of 12 feet was assumed for all three systems. It is found that the tracking range of the millimeter-wave radars is limited severely by atmospheric effects and by state-of-the-art transmitters and receivers. But there is a significant increase, as compared with the C-band radar, in the extent of the low angle region within which precision (0.1 mil) tracking kan be realized. Author (GRA)

N72-11164# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**ERROR RATES FOR SQUARE LAW COMBINING RECEIVERS**
Steven L. Bernstein 14 May 1971 22 p refs
(Contract F19628-70-C-0230; AF Proj. 1508A)
(AD-725040; TN-1971-31; ESD-TR-71-144) Avail: NTIS CSCL 17/2

Error rates for square-law combining receivers operating with random phase, non-fading channels are calculated and discussed. Practical applications include the selection of code work parameters and specifying the required degree of diversity for receivers with multiple inputs. Combining losses and combining inefficiency are examined. Both binary and M-ary signalling are considered. Author (GRA)

N72-11165# RAND Corp., Santa Monica, Calif.
**THE RAND VIDEO GRAPHIC SYSTEM: AN APPROACH TO A GENERAL USER-COMPUTER GRAPHIC COMMUNICATION SYSTEM**
K. W. Uncapher Apr. 1971 22 p refs Presented at the 20th AGARD Avionics Panel Tech. Symp. on Data Handling Devices, Istanbul 1-4 Jun. 1970
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-725809; R-753-ARPA) Avail: NTIS CSCL 09/2

Cathode-ray-tube graphic displays offer one of the most powerful and useful man-machine communication paths. The Rand Video Graphic System offers one implementation. It serves 32 consoles; each has a full range of interaction and full graphics, and accommodates up to 8 different input devices. Each console serves as the general graphic terminal for all the user's computer-based needs. The user can access several computers from any terminal. The system is based on the use of 873-line TV monitor in each terminal. Scan conversion and buffered storage are centralized to improve performance and reduce cost. The report describes system components, operating environment, hardware and software, consoles, and reliability and performance. An all-digital approach to the video system is now being designed at Rand. Author (GRA)

N72-11166# Naval Research Lab., Washington, D.C.
**SOME PROPERTIES OF A GENERALIZED MOVING-WINDOW BINARY DETECTOR Interim Report**
J. J. Freeman 28 May 1971 14 p refs
(NRL Proj. R-03-11)
(AD-725503; NRL-7279) Avail: NTIS CSCL 09/4

For a pulsed binary detector system, when one is given the probability that a target register a 1 is p sub k, where k indexes the relative position of the target with respect to the edge (or some arbitrary benchmark) of the antenna pattern, both the optimum linear detector and the likelihood ratio detector are shown to be weighted moving windows. A rigorous formula for the probability of detection of a moving window is derived (for the case p sub k is a constant) which consists of a finite series, of which the first few terms suffice for reasonable accuracy. Author (GRA)

# 08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

N72-11167 North Carolina State Univ., Raleigh.
**A LIMITED-VOCABULARY, MULTI-SPEAKER AUTOMATIC ISOLATED WORD RECOGNITION SYSTEM Ph.D. Thesis**
James Erving Paul, Jr. 1970 152 p
Avail: Univ. Microfilms Order No. 70-18975

Techniques for automatic recognition of isolated words are investigated, and a computer simulation of a word recognition system is effected. The following aspects of the system are considered in detail: data acquisition and digitizing, word detection, amplitude and time normalization, short-time spectral estimation including spectral windowing, spectral envelope approximation parametric and adaptive feature extraction, and pattern classification. Recognition parameters are derived from estimated short-time power spectra. An evaluation of spectral windows is made resulting in the selection of the hanning window. Fourier transformation of finite length time series is discussed along with the modified periodogram. A convolutional smoothing method of spectral envelope approximation is developed, and several smoothing windows are compared. The overall word recognition system was found to perform very satisfactorily with recognition accuracies reaching 99 percent for a single-speaker, 50-word vocabulary and 90 percent for a three-speaker, 30-word vocabulary. Author

N72-11168 Purdue Univ., Lafayette, Ind.
**CODES FOR PROTECTION FROM SYNCHRONIZATION LOSS AND ADDITIVE ERRORS Ph.D. Thesis**
George Robert Redinbo 1970 125 p
Avail: Univ. Microfilms Order No. 70-18717

Cyclic codes with symbols from a general finite field are modified so that they are also capable of protecting against misframing at the decoder. These codes are modified by altering their distance structure. There are a number of techniques which are employed. Each method affects different aspects of the code's performance; therefore a complete and comprehensive coverage of all techniques is given. Dissert. Abstr.

N72-11169 Washington Univ., St. Louis, Mo.
**DIGITAL DATA RATE OF CLIPPED, TIME-QUANTIZED SPEECH Ph.D. Thesis**
Venkatsiengar Ramakrishna 1970 93 p
Avail: Univ. Microfilms Order No. 70-18953

Speech was clipped to obtain a two-level analog waveform whose transitions correspond to the zero crossings of speech. The clipped speech was then time-quantized by allowing the speech to switch only at a set of predetermined instants. Clipped, time-quantized speech was modelled as a two-state

binary process, the two states corresponding to the voiced and unvoiced portions of speech. The short-time average zero crossing rate of speech was used as the criterion for segmenting speech into voiced and unvoiced portions. Substitution of the zeros of a white noise process during the unvoiced portions did not affect the intelligibility. This resulted in an estimate of the information rate, which is given by the voiced entropy. An investigation of the error sensitivity of the zero crossings of voiced sounds indicates that the bound on the average error probability per source letter is about 0.004. Dissert. Abstr.

**N72-11170** Pennsylvania State Univ., University Park.
**A HYBRID COMPUTER STUDY OF THE PROBABILISTIC PURSUIT-EVASION PROBLEM Ph.D. Thesis**
Theodore Eugene Stevenson 1969 183 p
Avail: Univ. Microfilms Order No. 70-19475

Hybrid statistical simulation affords one very practical approach to complicated stochastic problems. The object of this investigation was to use this approach to investigate the intercept capability of a single pursuer which gave chase to a target capable of both deterministic evasion and random maneuvers. Systems dynamics were modeled on an EAI 680 analog computer, in order to take advantage of the fast solution rates afforded by the repetitive operation models. A PDP-10 was used to automatically control the analog machine and to record data for processing. The pursuer was modeled to include a periodic sampling rate (to represent radar or sonar) and an amount of damping (to retard the flexibility of motion). These two parameters were chosen to be related to arbitrarily selected probabilities of intercept, where an intercept was required to take place within a fixed time following the initialization of a pursuit-evasion encounter. This problem was formulated in order to demonstrate a proposed method for determining design graphs for the pursuer. Dissert. Abstr.

**N72-11171*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**METHOD AND APPARATUS FOR DATA COMPRESSION BY A DECREASING SLOPE THRESHOLD TEST Patent**
Leonard Kleinrock, inventor (to NASA) Issued 10 Aug. 1971 7 p Filed 4 Apr. 1969 Sponsored by NASA
(NASA-Case-NPO-10769; US-Patent-3,598,921; US-Patent-Appl-SN-813494; US-Patent-Class-179-15.55R)
Avail: US Patent Office CSCL 09B

A method and apparatus are described for data compression by a decreasing slope threshold test in which the data stream is examined. Only those samples are selected for transmission which have a slope (first difference or first derivative) that exceeds an exponentially decreasing range established by a decreasing voltage added to and subtracted from a slope measurement at the time the last sample was transmitted. The time between successive transmissions is also transmitted in order that the reconstructed function may be formed by linear interpolation of the transmitted samples.
Official Gazette of the U.S. Patent Office

**N72-11172*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ANALOG SPATIAL MANEUVER COMPUTER Patent**
George E. MacVeigh, inventor (to NASA) Issued 17 Aug. 1971 11 p Filed 6 Jun. 1969 Supersedes N69-31277 (07 - 17, p 3123)
(NASA-Case-GSC-10880-1; US-Patent-3,599,335; US-Patent-Appl-SN-831118; US-Patent-Class-33-15A; US-Patent-Class-33-204C; US-Patent-Class-235-61NV) Avail: US Patent Office CSCL 09B

An analog spatial maneuver computer is described which provides an indication of three output angles through which a body in space must move so as to obtain a desired spatial attitude. These output angles are obtained by means of gimbal rings arranged concentrically or connected by axles. The gimbals are selectively adjustable so that one of the rings indicates a first spatial attitude of the body and another indicates the desired attitude of the body. The ring indicating the body's first spatial attitude is placed by selective adjustment of other rings among which is a third ring adjusted to represent a plane tangent to the earth at a known point; a fourth ring representing a spatial attitude of an earth support for the body prior to the time it is placed in space; and a fifth ring's attitude is adjusted to correspond to an inertial reference device. Other selectively adjustable rings can be added to correct for drift of the inertial reference means. Official Gazette of the U.S. Patent Office

**N72-11173*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DEVELOPMENT AND TESTING OF THE CENTRAL COMPUTER AND SEQUENCER FOR THE MARINER MARS 1971 SPACECRAFT**
U. Stanley Lingon 15 Oct. 1971 16 p ref
(Contract NAS7-100)
(NASA-CR-123358; JPL-TM-33-501) Avail: NTIS CSCL 09B

The central computer and sequencer subsystem has been an important part of the Mariner series of interplanetary spacecraft since their inception. As with other spacecraft subsystems, the CC&S has increased in complexity and capability with each spacecraft project. This report describes the design, fabrication, and test associated with the development of the Mariner Mars 1971 CC&S subsystem. Author

**N72-11174#** Advisory Group for Aerospace Research and Development, Paris (France).
**ARTIFICIAL INTELLIGENCE**
Thomas G. Evans, ed. Sep. 1971 324 p refs Presented at AGARD Avionics Panel Tech. Symp. on Artificial Intelligence, Rome, 24-28 May 1971
(AGARD-CP-94-71) Avail: NTIS HC $6.00/MF $0.95

The conference papers on artificial intelligence with emphasis on pattern recognition is reported. Other areas covered were robotry and robot vision, question-answering, natural language and speech recognition and man-machine interactive problem solving.

**N72-11175#** Grumman Aerospace Corp., Bethpage, N.Y.
**ESTABLISHING REQUIREMENTS FOR ARTIFICIAL INTELLIGENCE IN THE AIRBORNE AND SPACE ENVIRONMENTS**
Robert S. Aha *In* AGARD Artificial Intelligence Sep. 1971 9 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

Man-machine comparisons and basic requirement parameters for those most crucial operational problems for airborne, space, and non-terrain operations, wherein man must make use of artificial intelligence techniques, are delineated. Operational areas discussed are: safety of flight in flying close to the earth missions for surveillance and reconnaissance operations, aircraft control in the vicinity of airports, space shuttle docking, and other critical operations. Author

**N72-11176#** Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Science.
**ROBOT DATA SCREENING: AN INTELLIGENT (?) DATA SEARCH TECHNIQUE**
Theodor D. Sterling *In* AGARD Artificial Intelligence Sep. 1971 8 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The process of robot data screening is described and an evaluation is made of its potential as a possible heuristic procedure to aid in sorting out the most important features in an aggregate of emperical observations. Robot screening uses a measure of relevance of variables derived from the usefulness of variables to serve as predictors for the outcomes of observations. It is pointed out that, although probability of correct cross-classification is a satisfactory method, entropy constitutes a more suitable criteria for determining relevance. In robot screening, the entropy produced with each cross classification is examined and those that indicate the largest change in entropy are selected. Special tests are then applied to each variable or

variable combinations to see if its use is an improvement over the use of no or fewer predictors. As a final step, a search algorithm provides a practical method to converge upon the more useful cross-classification variable combinations. D.L.G.

N72-11177# Democritus Nuclear Research Center, Athens (Greece). Electronic Computers Div.
**ON TYE QUESTION ANSWERING SYSTEM DELFI AND ITS APPLICATION**
J. Kontos and A. Kossides *In* AGARD Artificial Intelligence Sep. 1971 6 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The latest version of the question-answering system DELFI is described and examples of its application are given. DELFI is based on the automatic generation of programs that express the meaning of English-like sentences via a procedural intermediate language. The general characteristics of DELFI are mass storage data-base, variety of application, modular design and almost realistic scale of performance. The English-like sentences accepted by DELFI include statements, questions, commands, and conditional sentences. These sentences are parsed and translated by a grammar-directed semantic interpreter into programs in a high-level procedural language composed from procedural semantic components. The procedural semantic components used perform operations which are of logical, set processing, data flow control and program flow control kind respectively. The programs generated have access to the data-base for updating and retrieval. Examples of application of DELFI are given in data management, picture processing and simple problem solving.
Author

N72-11178# IBM Italia, Rome.
**AN APPROACH TO NATURAL LANGUAGE FOR COMMAND AND CONTROL SYSTEMS**
A. Lanzara *In* AGARD Artificial Intelligence Sep. 1971 9 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The feasibility was examined of defining a highly user-oriented language, as close as possible to a natural language, for command and control systems. Several different language models were analyzed. Because of the recognized difficulty of computer programs to fully understand a natural language, the study goal was changed to the identification of a habitual language. The suitability of different models to describe the habitual language is discussed and the most promising model is selected. Possible methodology to be used to tailor the model to a particular command and control environment is also discussed.
D.L.G.

N72-11179# Rome Air Development Center, Griffiss AFB, N.Y.
**AUTOMATIC SPEAKER RECOGNITION SYSTEMS**
Bruno Beek, James Grech, and Willard F. Meeker (RCA, Camden, N. J.) *In* AGARD Artificial Intelligence Sep. 1971 7 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

Two systems, with variations, for speaker recognition are described. The recognition decisions are made automatically from continuous speech, uncontrolled as to context. One system uses primarily pitch and spectral characteristics obtained from voiced sounds. The other system employs automatic speech recognition circuitry to extract phonemes so that the spectral characteristics of each phoneme type can be tabulated separately. The characteristic manner in which individual phonemes are pronounced by different speakers is used to identify or differentiate between speakers. Results obtained with 30 speakers are presented.
Author

N72-11180# National Research Council of Canada, Ottawa (Ontario). Control Systems Lab.
**EXPERIMENTS WITH A HEURISTIC ON-LINE PICTURE PROCESSING LANGUAGE**
T. Kasvand *In* AGARD Artificial Intelligence Sep. 1971 5 p (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

A short description of a heuristic picture processing, learning and recognition system is outlined. It is shown that it is possible to construct a pattern recognition system which is independent of picture content. The objects in the picture are fragmented (if they are complicated), descriptions for the fragments (atoms) are formed and normalized before they are recognized. The inter-relationships between the atoms composing an object are stored. During recognition these inter-relationships are used in a procedure resembling hypotheses testing. A simplified version of the proposed system was programmed and gave adequate results.
Author

N72-11181# Communications Research Centre, Ottawa (Ontario).
**WEATHER RADAR IMAGE PROCESSING**
A. W. Bridgewater *In* AGARD Artificial Intelligence Sep. 1971 13 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The use is explored of computer image-processing for feature extraction in PPI displays of radar backscatter. The picture is transformed or 'processed' in order to reveal to the human analyst certain structural parameters of the patterns which are not directly accessible by visual inspection. Once identified, these parameters are extracted automatically and summary statistics of precipitation characteristics can be built up for long sequences of pictures. In the search for suitable features to describe the attenuation phenomena, the two-dimensional autocorrelation function of the image is shown to be useful. It is implemented digitally using the fast Fourier transform algorithm and it results in relatively regular, smoothly contoured structures which indicate average measures of ellipticity, directivity, periodicity, and correlation distances of the echo patterns. Data reduction methods for quantifying and extracting these features are described.
Author

N72-11182# Plessey Co., Ltd., Havant (England). Electronics Research Lab.
**A PRACTICAL APPLICATION OF PATTERN RECOGNITION**
C. J. W. Mason and O. E. Morgan *In* AGARD Artificial Intelligence Sep. 1971 8 p ref (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

A study was made of the application of pattern recognition techniques, using partitioning of data in n-space, to the detection of personnel who may be moving at a rate comparable with that of a clutter-producing environment. The sensor employed was a Doppler radar. Details of the processing and results are given. Feasibility of the techniques is demonstrated.
Author

N72-11183# Transportation Systems Center, Cambridge, Mass.
**AUTOMATIC DETECTION OF VEHICLES IN AERIAL PHOTOGRAPHS OF HIGHWAYS**
Juris G. Raudseps *In* AGARD Artificial Intelligence Sep. 1971 8 p (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The problem of time and effort involved in the data reduction process with information obtained through aerial photographs of highways is dealt with. An approach to automating the data reduction process is described. Techniques from the fields of interactive computer graphics and automatic pattern recognition are used in combination to reduce the amount of human effort required. A computer - controlled flying - spot scanner is used to scan the photographs. By means of a graphics tablet and stylus, a human operator selects ground reference points, delineates road boundaries, and may mark vehicles. The computer extrapolates the trajectories of vehicles to predict their positions in successive photographs. Their precise locations are then determined and recorded by applying pattern recognition techniques, matching the vehicle images in the current frame against their recorded images in the previous frame of photography.
Author

N72-11184# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
**AUTOMATIC MEDICAL DIAGNOSIS USING NONPARAMETRIC SEQUENTIAL CLASSIFICATION PROCEDURES**
K. S. Fu and M. H. Loew *In* AGARD Artificial Intelligence Sep. 1971 9 p refs (See N72-11174 02-08)
(Grant AF-AFOSR-1776-69)
Avail: NTIS HC $6.00/MF $0.95

Two nonparametric sequential classification procedures are applied to medical diagnosis problems. The procedures include: (1) sequential classification using nonparametric partition, and (2) sequential classification using nonparametric ranking. Specific results of some real-data medical diagnosis are presented for the problems of separating primary liver cancer from primary cancer of the pancreas, and for the separation of those from normal cases. The measurements (features) used are blood chemistry and hematology values, urinalysis, X-ray and liver scan results, and ECG and EEG analysis. Classifications for the training data were determined according to the patients' most recent diagnosis, either by biopsy at surgery or pathology at autopsy. The results obtained from these two proposed procedures are compared and their corresponding advantages and disadvantages are discussed. Author

N72-11185# Bunker-Ramo Corp., Westlake Village, Calif.
**FIXED AND ADAPTIVE ALGORITHMS FOR PATTERN RECOGNITION: PROBLEMS IN THEORY AND APPLICATION**
C. M. Bertone and F. A. Muckler (Manned Systems Sci., Inc.) *In* AGARD Artificial Intelligence Sep. 1971 13 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

Based on recent Soviet and American theoretical developments, information is presented on adaptive and self-organizing algorithms and problems in applications, specifically in multiple sonar input processing and voice encoding. In addition, detailed descriptions are given of Soviet work in computer-aided medical diagnostics. Author

N72-11186# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
**COMPUTER PROCESSING OF NATURAL SCENES: SOME UNSOLVED PROBLEMS**
Ugo Montanari (CNR, Pisa, Italy) and Raj Reddy *In* AGARD Artificial Intelligence Sep. 1971 5 p refs (See N72-11174 02-08)
(Contract F44620-70-C-0107)
Avail: NTIS HC $6.00/MF $0.95

The problem is considered of extending the present methods used in visual image processing to the analysis of natural scenes. The limitations are discussed of presently used techniques, such as edge detection algorithms, two-dimensional Fourier transforms and linguistic methods. In addition, recommendations are proposed for future research in processes which appear to be promising. D.L.G.

N72-11187# Consiglio Nazionale delle Ricerche, Rome (Italy).
**KINEMATIC ASPECTS OF PROJECT OF UNCONVENTIONAL LOCOMOTION VEHICLES**
T. Leo and R. Vitelli *In* AGARD Artificial Intelligence Sep. 1971 10 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The development is reported of an unconventional locomotion vehicle, capable of moving on jointed legs and performing rectilinear displacements on an horizontal plane. Movement is automatically controlled by input signals but the degree of control is limited to translational speed. The problem considered involves the additional development of a steering control system. A theoretical study is described in which a heuristic approach to the problem is taken. The minimum possible number of degrees of freedom are used, and stability conditions of vehicle motion and other given constraints on locomotion are respected. In addition, complete automation of the vehicle is maintained. D.L.G.

N72-11188# Aerojet-General Corp., Azusa, Calif.
**RECOGNIZING THREE DIMENSIONAL OBJECTS BY THEIR SILHOUETTES**
J. Sklansky and G. A. Davison, Jr. *In* AGARD Artificial Intelligence Sep. 1971 11 p refs Prepared in cooperation with Calif. Univ., Irvine (See N72-11174 02-08)
(Contract F33615-69-C-1314)
Avail: NTIS HC $6.00/MF $0.95

A method is described for classifying or identifying a three-dimensional object from one or more of its silhouettes. The method is based on a low-cost parallel mechanism for computing the slope density of the edge of the silhouette. The proposed technique computes the slope density by a circularly nutating array of photodetectors. The slope density is then passed through a set of narrow-band-pass filters, yielding the Fourier harmonics of the slope density. In order to take account of varying aspect angles of the original object, the object is represented by a number of prototypes; each prototype being a vector of the Fourier harmonics of the slope density. These prototypes appear in a decision tree that makes the final recognition. An experimental machine implementing this technique is described, and the results obtained with the machine for recognizing five classes of aircraft are given. Author

N72-11189# Texas Univ., Austin. Dept. of Electrical Engineering.
**SEQUENTIAL STRUCTURE AND PARAMETER ADAPTIVE PATTERN RECOGNITION. PART 1: SUPERVISED LEARNING**
D. G. Lainiotis *In* AGARD Artificial Intelligence Sep. 1971 11 p refs (See N72-11174 02-08)
(Grants AF-AFOSR-1764-69; AF-AFOSR-0766-67E)
Avail: NTIS HC $6.00/MF $0.95

Recursive filters for supervised learning Bayes-optimal adaptive pattern recognition with continuous data are derived. Both off-line (or prior to actual operation) and on-line (while in operation) supervised learning is considered. The concept of structure adaptation is introduced and both structure as well as parameter adaptive optimal pattern recognition systems are obtained. Specifically, for the class of supervised learning pattern recognition problems with Gaussian process models and linear dynamics, the adaptive pattern recognition systems are shown to be decomposable into a linear, non-adaptive part consisting of recursive, matched Kalman filters; a nonlinear part consisting of a set of probability computers that incorporates the adaptive nature of the system; and finally a linear part of the correlator-estimator form. Extensions of the above results to the M-ary hypotheses cases, where M > or = 2 are given. Author

N72-11190# North American Rockwell Corp., Thousand Oaks, Calif. Science Center.
**SEMI-ADAPTIVE APPROACH TO PATTERN RECOGNITION**
John M. Richardson *In* AGARD Artificial Intelligence Sep. 1971 7 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

Two kinds of approaches to pattern recognition, representing extreme limits of the adaptive-nonadaptive axis, are considered. These include: (1) the adaptive approach in which the prior information is composed mainly of pre-classified training patterns with a very limited amount of information designed into the system, and (2) the nonadaptive approach in which the prior information is composed entirely of information designed into the system. Emphasis is placed on deriving some intermediate approaches by combining various aspects of the two described approaches. The methodology employed involves the use of mathematical models of pattern classes to which decision theory is applied. The models, although stochastic, are partially indeterminate in the sense that some of the probability parameters are not completely known. In the adaption phase both Bayesian and non-Bayesian techniques are considered for the reduction of model indeterminacy through pre-classified samples. D.L.G.

N72-11191# Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium).
**A GENERAL ORDER MINKOWSKI METRIC PATTERN CLASSIFIER**
Pierre A. Devijver *In* AGARD Artificial Intelligence Sep. 1971 11 p refs (See N72-11174 02-08)
Avail: NTIS $6.00/MF $0.95

One general category of multiclass deterministic pattern recognition systems is defined by a linear structure in the input variables and an analytical criterion. This criterion requires the minimization of the average pth power of one Minkowski distance measure of order p in one particular decision space. Analytical reasoning indicates that the criterion yields an error-correcting procedure. The procedure results in a reduction of the number of misclassifications when the order of the criterion metric is increased. This feature renders the criterion particularly well suited to nonseparable problems. It is briefly mentioned how this design criterion may be used to produce optimized decision surfaces in the separable two class case, as it tends to maximize the minimum distance from each class to the decision surface. The Bayesian distribution-free classifier appears as a special case of the general category of classifiers defined by the criterion. Author

N72-11192# Florida Univ., Gainesville. Center for Informatics Research.
**PREPROCESSING FOR PICTORIAL PATTERN RECOGNITION**
R. H. Cofer and J. T. Tou *In* AGARD Artificial Intelligence Sep. 1971 13 p refs (See N72-11174 02-08)
(Contract N00014-68-A-0173-0001)
Avail: NTIS HC $6.00/MF $0.95

An integrated preprocessing system is presented for the purpose of line extraction. This system consists of six stages, each of which reduces an abstract, i.e. defined, line network of a picture to a form which represents the physical line structure more meaningfully or efficiently. In operation, the picture is first stripped of all spurious objects and holes. A connected medial axis is then found for each object in order to reduce the line width. This is followed by removal of all 4-point loops, resulting everywhere in abstract lines of unit thickness. Noise branches, a natural result of the prior processing technique, are then removed. For greater processing flexibility, the abstract line structure is then inserted into a list data structure composed of line, junction, and endpoint entries. The resulting structure is then further processed in order to improve the representation of those junctions of many lines. The final representation of the picture serves as an ordered, high-level data base upon which further pattern analysis, recognition, or processing may be conducted. Author

N72-11193# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
**A NAIVE METHOD FOR MACHINE RECOGNITION OF HAND WRITTEN NUMERALS**
M. Beun *In* AGARD Artificial Intelligence Sep. 1971 10 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

A method for character recognition by machines is described. The character to be recognized is scanned to obtain a matrix of black and white dots, to which a thinning process is then applied. This process, which has built in a precaution not to destroy connectivity, produces a skeleton of which no further point kan be removed without either destroying connectivity or eating away end points. Features as end points and junctions are now readily detected and their occurrence and relative positions provide the basis of a recognition scheme. The recognition scheme is so made up that more and finer recognition criteria can be added when needed, without basically affecting the recognition possibilities already attained. Moreover, as more experience is gained as to the most effective criteria, a completely fresh start often produces a new recognition scheme that is simpler and more powerful than its predecessors. Author

N72-11194# Siemens A.G., Munich (West Germany).
**HOLOGRAPHIC PATTERN RECOGNITION USING A MULTICHANNEL CORRELATOR**
G. Winzer and N. Douklies *In* AGARD Artificial Intelligence Sep. 1971 12 p refs Sponsored by Bundesmin. fuer Bildung und Wiss. (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

A multichannel correlator for holographic matched filtering is described. The channels are separated spatially in the Fourier-plane. This arrangement allows individual filters to be realized for each channel for different spatial frequency ranges etc. The multichannel correlator is addressed by a generator of multiple object waves, i.e. by different directions of object illumination. Parallel and sequential evaluation of the correlation signals is possible. The efficiency and signal-to-noise ratio for both modes of operation are discussed. In each channel linear superimposed multiple Vander-Lugt filters may be introduced to increase the overall capacity of learning steps. The risk of overexposure is very small because the centers of the frequency spectra are separated on the hologram filter plate. With a multichannel correlator combined matched and feature filtering may be performed. Preliminary experimental results show that this method can be successfully used in some cases where the results of simple matched filtering remain unsatisfactory. The results and discussions are presented from a more general point of view with some remarks concerning comparable methods and possible future aspects. Author

N72-11195# Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Karlsruhe (West Germany). Inst. fuer Informationsverarbeitung.
**OPTICAL PATTERN PROCESSING FOR RECOGNITION**
E. Muehlenfeld *In* AGARD Artificial Intelligence Sep. 1971 7 p refs (See N72-11174 02-08)
Avail: NTIS $6.00/MF $0.95

Optical processing is discussed as a useful tool for compressing pattern information by feature extraction. Topics discussed include: compression of pattern information, recognition of pattern vectors, and parallel processing. F.O.S.

N72-11196# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Satellitenelektronik.
**AN IMAGE PROCESSING AND PATTERN RECOGNITION SYSTEM FOR TIME VARIANT IMAGES USING TV CAMERAS AND A MATRIX COMPUTER**
Ernst E. Triendl *In* AGARD Artificial Intelligence Sep. 1971 10 p (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

An artificial visual system is discussed with desirable characteristics similar to those of a mammalian visual system. The general structure is described and includes; sensors, cameras, video reduction and input to the matrix processor, and master computer. F.O.S.

N72-11197# Technische Hogeschool, Delft (Netherlands).
**THE STORAGE OF VIDEO INFORMATION IN A MEMORY**
P. H. T. VanDerMeer *In* AGARD Artificial Intelligence Sep. 1971 7 p ref (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The basic principles of the video-to-digital converter for storage of video information with small memory systems are presented. A composite video signal generated by the TV camera is considered to be made up of a brightness and a synchronization signal. The output of the converter consists of the brightness in a binary form, which is transferred to the core memory of a PDP 9 computer. Information reduction and compression limit the number of memory places required for storage of TV images. F.O.S.

N72-11198# University Coll., London (England). Dept. of Physics.
**CELLULAR LOGIC AND ITS SIGNIFICANCE IN PATTERN**

**RECOGNITION**
M. J. B. Duff *In* AGARD Artificial Intelligence Sep. 1971 13 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The use of cellular logic in the solution of pattern recognition problems is discussed. Two classes of cellular logic arrays were investigated for pattern preprocessing. The class consists of variable function arrays with nearest neighbor connection, and the other depends on switching circuits linked by diodes. F.O.S.

**N72-11199#** Vanderbilt Univ., Nashville, Tenn.
**A MAN-MACHINE APPROACH TOWARD SOLVING VARIOUS ROUTING, SCHEDULING, AND NETWORK PROBLEMS**
Patrick Krolak, Wayne Felts, and James M. Nelson *In* AGARD Artificial Intelligence Sep. 1971 12 p refs (See N72-11174 02-08)
(Grant NSF GK-4975)
Avail: NTIS HC $6.00/MF $0.95

A man-machine approach is presented for solving problems of the following types: traveling salesman, generalized truck dispatching, board wiring, and construction of minimum cost communication networks with survival or redundancy demands. The truck dispatching problem is considered in detail, and the man-machine process, data organization, computer heuristics, and the interactive phase are discussed. F.O.S.

**N72-11200#** Bell Aerospace Co., Buffalo, N.Y.
**PROCESSING AND DISPLAY OF TIME VARYING SPECTRAL INFORMATION WITH APPLICATION TO SONAR, VOICE, AND MEDICAL SIGNALS**
Lester A. Gerhardt *In* AGARD Artificial Intelligence Sep. 1971 12 p refs Prepared in cooperation with Rensselaer Polytech. Inst. (See N72-11174 02-08)
(Contract AF 49(638)-1627)
Avail: NTIS HC $6.00/MF $0.95

The representation of a nonstationary signal by a time varying spectral display (TVSD) is described. Methods of generating the information used in a TVSD are discussed, with emphasis on on-line, real time techniques. Several methods of displaying this information are presented, including computer and television generated images. General examples of processing the time varying spectral data are given with respect to periodic and aperiodic signal features. The applications of the TVSD are also presented. Selected research in the fields of Sonar, Voice, and Medical signal processing is discussed. The usefulness of the TVSD is demonstrated by examples using the lofargram, voikeprint, and phonocardiogram in each of these three fields, respectively. Author

**N72-11201#** General Electric Co., Syracuse, N.Y.
**SIGNAL ANALYSIS AND CLASSIFICATION BY INTERACTIVE COMPUTER GRAPHICS**
A. W. Whitney and W. E. Blasdell *In* AGARD Artificial Intelligence Sep. 1971 10 p refs (See N72-11174 02-08)
(Contract F30602-69-C-0227)
Avail: NTIS HC $6.00/MF $0.95

Many aspects of signal analysis and classification are briefly discussed and techniques are given for employing an interactive computer graphics facility to design signal classification systems. The signal classification problems addressed are characterized by the fact that the classification information present in the signals must be extracted from a limited number of identified signals. Author

**N72-11202#** Rome Air Development Center, Griffiss AFB, N.Y.
**ON THE DESIGN OF WAVEFORM CLASSIFICATION SYSTEMS BY INTERACTIVE MAN-MACHINE METHODS**
H. E. Webb, Jr. and D. H. Foley *In* AGARD Artificial Intelligence Sep. 1971 19 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

A waveform processing system is proposed for feature extractor design. The editing, transformation, basic function expansion, digital filtering, and local feature operation are described. An on-line pattern analysis and recognition system is also discussed as a research tool for aiding analysts in designing classification logic. Author

**N72-11203#** International Computers, Ltd., Kidsgrove (England).
**NEW TECHNIQUES IN INTERACTIVE GRAPHIC CONSOLE DESIGN FACILITATING THE PRESENTATION AND MANIPULATION OF COMPLEX DATA**
G. Hughes *In* AGARD Artificial Intelligence Sep. 1971 9 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

An experimental method by which the techniques of interactive line graphics may be extended to the handling of pictoral data is described. This involves a combination of a new storage scan converter with conventional digital incremental computational techniques. Indications are made as to how the method may be applied to pattern recognition and visual artificial intelligence problems and the manner in which the system may be enhanced to cater for color pictures is outlined. In addition to the above enhancements to cater for picture manipulation an enumeration of the problems in display presentation of pictorial data in an interactive terminal and a potential method of enhancement is briefly described. Author

**N72-11204#** Compagnie Generale de Telegraphie sans Fil, Paris (France).
**DIGITAL FILTERING PROCEDURES FOR A LINE IMAGE [PROCEDES DE FILTRAGE DIGITAL D'UNE IMAGE DE LIGNES]**
J. C. Simon and A. Checroun *In* AGARD Artificial Intelligence Sep. 1971 14 p refs In FRENCH; ENGLISH summary (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The use of computers to analyze data which modifies the usual representation concepts are discussed. The following constraints introduced by computers are analyzed: digitization, memory size, and algorithmic treatments. An adaptation of the conventional filtering processes of an image leads to digital filters, which are well suited to arithmetic computation. These principles are applied to the optimal storage of an image, to the reduction of information volume, and to the first level features extractions. The PPI radar information is processed by these methods. The aim is to reduce the available information to a few specific features, that will describe a radar situation. Hill ridges are such features. They are automatically extracted and represented by lines, which are then coded and stored. Author

**N72-11205#** Karlsruhe Univ. (West Germany). Inst. for Inform. and Transmission.
**GENERATION OF LINE DRAWINGS FROM GREY-SCALE PICTURES**
F. Holdermann and H. Kazmierczak *In* AGARD Artifial Intelligence Sep. 1971 14 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

The problem of detecting boundaries of objects in gray scale pictures is studied. An object is defined as a region with a reasonable uniform distribution of intensities. Three methods are presented and the results of their applications to some areal photos are discussed. The detected boundaries are given by differential line elements which are described in each picture point by a direction, characterizing the orientation of the boundary, and by a weight, characterizing the amount of the gradient of the intensity distribution. A filtering and a contour tracing algorithm, based on the direction and weight information of the boundaries are briefly discussed. Author

**N72-11206#** Technical Univ. of Denmark, Lyngby. Electronics Lab.
**PATTERN RECOGNITION USING DYNAMIC PICTORIAL INFORMATION**



THE UNIVERSITY OF MICHIGAN LIBRARIES

Peter W. Becker and Knud A. Nielson *In* AGARD Artificial Intelligence Sep. 1971 6 p refs (See N72-11174 02-08)
Avail: NTIS HC $6.00/MF $0.95

Problem solving with man-machine interaction was considered for pattern recognition using both static and dynamic information. Topics discussed include: recognition of handprinted digits, recognition logic, dynamic attributes, and static attributes. It is concluded that the use of dynamic pictorial information simplifies recognition of picture patterns. F.O.S.

**N72-11207*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DEXTER: A ONE-DIMENSIONAL CODE FOR CALCULATING THERMIONIC PERFORMANCE OF LONG CONVERTERS**
C. D. Sawyer 15 Nov. 1971 19 p refs
(Contract NAS7-100)
(NASA-CR-123327; JPL-TR-32-1545) Avail: NTIS CSCL 09B

A versatile code is described for computing the coupled thermionic electric-thermal performance of long thermionic converters in which the temperature and voltage variations cannot be neglected. The code is capable of accounting for a variety of external electrical connection schemes, coolant flow paths and converter failures by partial shorting. Example problem solutions are included along with a user's manual. Author

**N72-11208*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**NUMERICAL COMPUTER PERIPHERAL INTERACTIVE DEVICE WITH MANUAL CONTROLS Patent Application**
Arthur I. Zygielbaum and Stanley S. Brokl, inventors (to NASA) Filed 22 Jun. 1971 12 p
(Contract NAS7-100)
(NASA-Case-NPO-11497; US-Patent-Appl-SN-155565) Avail: NTUS CSCL 09B

A computer peripheral device is disclosed which includes a joystick whose displacement from a center position along two axes X and Y in either a plus (+) or minus (-) direction is sensed. The displacement magnitude in either direction controls the rate of clock pulses provided by a variable frequency clock. The clock pulses from the two clocks are accumulated in two separate counters, whose contents are displayed. The contents of the counters can be supplied to a computer to update the contents of specific cells defining the position of a cursor on a display which is under computer control. NASA

**N72-11209*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**DIGITAL TO ANALOG CONVERSION APPARATUS AND METHOD Patent Application**
William P. Dotson, Jr., inventor (to NASA) Filed 13 Oct. 1971 26 p
(NASA-Case-MSC-12458-1; US-Patent-Appl-SN-188927) Avail: NTIS CSCL 09B

An apparatus and method for the construction of an analog signal from a digital input signal by interpolation between sample points in accordance with an nth order polynomial function are described. The digital to analog converter improves the accuracy of reconstructing a sampled analog signal without requiring that the sampling rate of the original signal be increased to obtain such accuracy. NASA

**N72-11210*#** Sandia Labs., Albuquerque, N.Mex. Planetary Quarantine Systems Studies Div.
**A COMPUTERIZED PROGRAM FOR STATISTICAL TREATMENT OF BIOLOGICAL DATA**
A. L. Roark and M. C. Reynolds Sep. 1971 26 p refs Sponsored in part by AEC
(NASA Order W-12853)
(NASA-CR-123352; SC-RR-710681) Avail: NTIS CSCL 09B

Biologists frequently conduct experiments which measure the patterns of inactivation of bacterial populations after exposure to a lethal environment. A computer program is discussed which calculates many of the quantities that have proven to be useful in the analysis of such experimental data. Author

**N72-11211#** California Univ., Livermore. Lawrence Radiation Lab.
**TWO-DIMENSIONAL STRESS-INDUCED ADIABATIC FLOW. PART 1: MAIN CODE**
V. Kransky, J. Owens, and J. T. Cherry 1 Apr. 1971 144 p
(Contract W-7405-eng-48)
(UCID-30013-Pt-1) Avail: NTIS

The FORTRAN listings are presented for the main code of the two-dimensional stress-induced adiabatic flow program TENSOR. Logic and calculational subroutines are included. D.L.G.

**N72-11212#** California Univ., Livermore. Lawrence Radiation Lab.
**TWO-DIMENSIONAL STRESS-INDUCED ADIABATIC FLOW. PART 2: GENERATOR CODE**
V. Kransky, J. Owens, and J. T. Cherry 1 Apr. 1971 56 p
(Contract W-7405-eng-48)
(UCID-30013-Pt-2) Avail: NTIS

Listings in FORTRAN are presented for the generator code of the two-dimensional stress-induced adiabatic flow program TENSOR. D.L.G.

**N72-11213#** California Univ., Livermore. Lawrence Radiation Lab.
**TWO-DIMENSIONAL STRESS-INDUCED ADIABATIC FLOW. PART 3: UNCLE: CODES OF TENSOR EXPLAINED**
V. Kransky, J. Owens, and J. T. Cherry 1 Apr. 1971 41 p
(Contract W-7405-eng-48)
(UCID-30013-Pt-3) Avail: NTIS

The U.N.C.L.E. listing is presented which explains the codes of TENSOR, a program for two-dimensional stress induced adiabatic flow. D.L.G.

**N72-11214#** Kansas Univ., Lawrence. Dept. of Chemistry.
**COMPUTER COLLECTION OF MASS SPECTROMETRIC IONIZATION EFFICIENCY CURVES**
Bruce R. Conard, Peter M. Fast, David L. Nordlund, and Paul W. Gilles 17 May 1971 10 p refs Presented at Conf. on Computers in Chem. Educ. and Res., DeKalb, Ill., 10-23 Jul. 1971
(Contract AT(11-1)-1140; Grant NSF GJ-332)
(COO-1140-198; Conf-710704-3) Avail: NTIS

A data acquisition and equipment control system used in a high temperature chemical laboratory are described. The design specifications for the hardware of the system and the software for one of the experiments are given. A collection of ionization efficiency curves obtained with a nuclide high temperature mass spectrometer is included. Descriptions are given of the hardware configuration adapted and the software developed for the data acquisition. Examples of data collected are shown. Author

**N72-11215#** Sandia Corp., Albuquerque, N.Mex. Advanced Instrumentation Development Div. 7211.
**THE 100-MHz ULTRASONIC GLASS DELAY LINE MEMORY**
Thomas A. Howard May 1971 69 p refs
(SC-DR-710169) Avail: NTIS

A 100-MHz 1000-bit serial memory employing an ultrasonic glass delay line as the storage medium was developed. The associated control logic is also discussed. The system has many applications where time-bandwidth exchange is required. Author

**N72-11216#** Illinois Univ., Urbana. Dept. of Computer Science.
**IMAGE PROCESSING AND PATTERN RECOGNITION RESEARCH: ILLIAC 3 Progress Report**

19 Apr. 1971 23 p refs Presented at AEC Computer Inform. Meeting, New York, 20-21 May 1971
(Contract AT(11-1)-2118)
(TID-25739) Avail: NTIS

The picture processing model attempts to develop the structure and semantics necessary to treat a general two-dimensional scene. The picture is initially mapped into a cellular mosaic: a segmentation of the scene into cells (e.g. regions bounded by simple curves) which then form primitives for further analysis. The choice of primitives strongly influences the development and the capability of the model. Cells seem to be far superior to primitives consisting primarily of line-elements, which were used in earlier approaches. Line-elements were often chosen to attempt to obtain a model based on one-dimensional and context-free grammars, which are inadequate in many cases. After the articulation of parts of the picture into cellular regions, spatial relationships and adjacency relationships can be conveniently expressed. Varying levels of attention can be applied to different regions by the choice of cells. Author (NSA)

**N72-11217#** California Univ., Livermore. Lawrence Radiation Lab.
**CORRECTED FLUORESCENCE SPECTRA BY COMPUTER POSTPROCESSING**
V. Alan Mode, David H. Sisson, and Carolyn A. Bailey Apr. 1971 8 p refs Presented at the Conf. on Computers in Chem. Educ. and Res., DeKalb, Ill., 19-23 Jul. 1971
(UCRL-73161; Conf-710704-1) Avail: NTIS

A simple technique is developed to determine the spectral distribution of the excitation source and, detect and correct any abnormalities in the fluorescence. The technique combines economics, use of conventional instruments, and a rapid postprocessing means. Results indicate high quality, corrected spectral data can be obtained from this method. E.H.W.

**N72-11218#** California Univ., Livermore. Lawrence Radiation Lab.
**LRL COMPUTER PROGRAM: MICROANALYSIS**
Wayne J. Steele 12 May 1971 25 p refs Presented at the 6th Natl. Conf. on Electron Probe Anal., Pittsburgh, 28-30 Jul. 1971
(UCRL-73104; Conf-710706-1) Avail: NTIS

A FORTRAN IV computer program, MICROANALYSIS, which converts raw data from an electron-beam microprobe analyzer into weight percent and atomic percent of the elements found in the analysis is described. The program requires a minimum of instructions per problem. It corrects for dead time, drift, continuum background, spectral background, absorption, secondary fluorescence, and atomic number. For samples having concentration gradients, the atomic and weight percentages are plotted as functions of distance from a fiducial mark on the sample. Results of the computerized microprobe analyses agree within 2% relative with chemical analyses made on NBS gold-copper standards. Author

**N72-11219#** California Univ., Livermore. Lawrence Radiation Lab.
**CALORIMETRY DATA ACQUISITION AND CONTROL**
J. C. English Feb. 1971 5 p Presented at DECUS Spring 1971 Symp., Atlanta, 13-15 May 1971
(UCRL-73046; Conf-710514-1) Avail: NTIS

The approach taken to use a PDP-8/I digital computer to control a calorimetry experiment is described. The software developed was an interrupt-driven, modified 8 k FOCAL 69, which allows on-line control with recursive interrupt handling. The command structure has been modified so that the hardware kan be controlled with new FOCAL commands. Author

**N72-11220#** Sandia Labs., Albuquerque, N.Mex.
**NUMERICAL TECHNIQUES FOR ONE-DIMENSIONAL RATE-DEPENDENT POROUS MATERIAL COMPACTION CALCULATIONS**
B. M. Butcher Apr. 1971 64 p refs Sponsored by AEC
(SC-RR-710112) Avail: NTIS

A numerical subroutine for the WONDY one-dimensional wave propagation code is described which can be used to solve both rate-dependent and rate-independent porous material problems. The method of solution is based on subcycling within the normal WONDY time step in order to minimize computation error in regions of high stress rate. Solutions determined with this subroutine are shown to agree with steady state analysis results. A method is also described which permits rational control of the effects of artificial viscosity on the calculation. Finally, the complete numerical technique is illustrated by results from a computer problem which simulated the impact of 0.96 gm/cc polyurethane foam by an aluminum plate. These results show that the distance for the 8.3 kbar compaction wave to become steady was approximately 0.5 cm, which is about three times the effective width of the steady wave profile. Author

**N72-11221#** Bendix Corp., Kansas City, Mo.
**EVALUATION OF METHODS FOR COMPUTER-AIDED DESIGN OF TEST EQUIPMENT** Final Report
Jul. 1971 37 p refs
(Contract AT(29-1)-613)
(BDX-613-349; PDO-6984640) Avail: NTIS

An evaluation was made of the circuit analysis capabilities that are available to the test equipment engineer through computer-aided design programs. The advantages, disadvantages, applications, and limitations of the SCEPTRE, ECAP, ECAP (COM-SHARE), and CODED CAP (COM-SHARE) programs are given, together with examples of programs formatted for use on the SCEPTRE and ECAP (COM SHARE) systems. Author

**N72-11020#** Eastern Air Lines, Inc., Miami, Fla.
**COMPUTER APPLICATION STRATEGY FOR CONTROL OF AIRLINE MAINTENANCE IN THE SEVENTIES**
J. P. Burke, J. P. DiBella, and J. B. Sabol *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 16 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

**N72-11022#** LTV Aerospace Corp., Dallas, Tex. Systems Effectiveness Dept.
**HARNESSING THE DIGITAL COMPUTER FOR AIRCRAFT MAINTENANCE**
R. F. Cook *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 12 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

# 09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

**N72-11222** National Lending Library for Science and Technology, Boston Spa (England).
**HIGH-VOLTAGE CERAMIC CONDENSERS**
N. P. Bogoroditskii et al Aug. 1971 12 p refs Transl. into ENGLISH from the book "Vysokovoltnye Keramicheskie Kondensatory" Moscow, 1970 p 90-104
(NLL-RTS-6608) Avail: Natl. Lending Library, Boston Spa, Engl.: £ 1.20; 4 NLL photocopy coupons

The mechanical properties of radio-ceramics are discussed. The origin and development of internal stresses in such materials are considered. The effects of cracks on the mechanical strength of ceramics are reviewed, as well as the dependence of mechanical strength on temperature and length of time of applied stress. K.P.D.

N72-11223 National Lending Library for Science and Technology, Boston Spa (England).
**RARE EARTH METALS AND THEIR COMPOUNDS AS MATERIALS FOR THERMIONIC CATHODES**
B. V. Bondavenko and B. M. Tsarev 8 Aug. 1971 8 p refs Transl. into ENGLISH from Probl. in the Theory and Appl. of the Rare Earth Metals, Nauka, 1964
(NLL-RRE-Trans-296-(8036.625)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

A review of research on refractory compounds of rare earth metals and their application in cathode electronics is presented. Particular attention is devoted to a discussion of the emission properties of borides and solid solution oxides. Tables are given for physico-chemical, thermoelectronic, and emission properties of lanthanum and rare earth metal compounds. K.P.D.

N72-11224* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HELICAL RECORDER ARRANGEMENT FOR MULTIPLE CHANNEL RECORDING ON BOTH SIDES OF THE TAPE Patent**
Pleasant T. Cole, Philip A. Studer, and Allen. L. Tyler, inventors (to NASA) Issued 13 Jul. 1971 7 p Filed 7 May 1969 Supersedes N69-33434 (07 - 19, p 3550)
(NASA-Case-GSC-10614-1; US-Patent-3,592,478; US-Patent-Appl-SN-822534; US-Patent-Class-274-4R; US-Patent-Class-179-100-2CA; US-Patent-Class-179-100-2MD) Avail: US Patent Office CSCL 09E

A recorder is described which employs a column of tape wrapped in a helix around a supporting drum. A direct drive torquer rotates the drum-tape assembly. Tape separators and heads are mounted on a traversing system so that they are completely supported by the tape. The separators flex the tape at an angle sufficient to allow the heads to clear the tape stack. As the tape rotates, the Archimedes screw effect causes the heads to track up and down the tape stack, thus traversing the entire length of the tape.
Official Gazette of the U.S. Patent Office

N72-11225* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**RIPPLE INDICATOR Patent**
Walter H. Houck and James K. Davidson, inventors (to NASA) Issued 13 Jul. 1971 4 p Field 18 Apr. 1969
(NASA-Case-KSC-10162; US-Patent-3,593,132; US-Patent-Appl-SN-817481; US-Patent-Class-324-102; US-Patent-Class-324-119; US-Patent-Class-324-123R) Avail: US Patent Office CSCL 09E

A circuit for monitoring a power supply is reported that determines when the voltage level of the power supply deviates. The circuit includes an isolating capacitor which blocks the dc portion of the power supply and allows the AC ripple to pass through. This ac ripple is fed to a balanced circuit which detects variations therein for indicating when the power supply deviates from a predetermined level.
Office Gazette of the U.S. Patent Office

N72-11226# Danish Research Centre for Applied Electronics, Copenhagen.
**FIXING OF EFFECTIVE COMPONENTS: A STUDY OF 12 MATERIAL COMBINATIONS FOR ELECTRICALLY ISOLATED FIXING OF EFFECTIVE TO-3 COMPONENTS. THERMAL RESISTANCE, ISOLATING RESISTANCE WITH BREAKDOWN AT IONIZATION VOLTAGE [OPSPAENDING AF EFFEKTKOMPONENTER: EN UNDERSOEGELSE AF 12 MATERIALEVARIANTER TIL ELEKTRISK ISOLERET OPSPAENDING AF TO-3 EFFEKTKOMPONENTER. TERMISK MODSTAND, ISOLATIONSMODSTAND SAMT GENNEMSLAGSSPAENDING UNDER FORSKELLIGE MILJOEFORHOLD]**
A. Laursen Sep. 1971 36 p In DANISH; ENGLISH summary
(ECR-23) Avail: NTIS

The thermal qualities of some of the materials used for electric isolation of highly heat generating semiconductors on heat sinks are evaluated. Only insulating resistance and breakdown voltage were examined (ionization voltage). The tests were carried out on materials for transistors in the TO 3 casing and results transferred to other sized casings where intermediate layers were used. Application of a beryllium oxide paste provided the lowest thermal conductivity values. Author

N72-11227# Technische Hochschule Munchen (West Germany). Fakultaet fuer Maschinenwesen und Elektrotechnik.
**THE BREAKDOWN BETWEEN HIGH VACUUM TUNGSTEN ELECTRODES AT LARGE SURGE VOLTAGE Ph.D. Thesis [DER HOCHVAKUUMDURCHBRUCH ZWISCHEN WOLFRAMELEKTRODEN BEI HOHER STOSSSPANNUNG]**
Ewald Bauer 1971 234 p refs In GERMAN
Avail: NTIS

The electrical breakdown behavior between tungsten electrodes in a high vacuum at sudden voltage surges is studied. Evaluation of surge characteristics and determinations of breakdown voltages and predischarge currents between cylindrical electrodes 3 mm distant from each other shows that free energy from predischarge electrons stopped at the anode produces the metal vapor responsible for vacuum arc breakdown.
Transl. by G.G.

N72-11228*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MAGNETIC MATERIALS SELECTION FOR STATIC INVERTER AND CONVERTER TRANSFORMERS**
Colonel W. T. McLyman 1 Nov. 1971 35 p refs
(Contract NAS7-100)
(NASA-CR-123359; JPL-TM-33-498) Avail: NTIS CSCL 09D

Different magnetic alloys best suited for high-frequency and high-efficiency applications were comparatively investigated together with an investigation of each alloy's inherent characteristics. One of the characteristics in magnetic materials deterimental in transformer design is the residual flux density, which can be additive on turn-on and cause the transformer to saturate. Investigation of this problem led to the design of a transformer with a very low residual flux. Tests were performed to determine the dc and ac magnetic properties at 2400 Hz using square-wave excitation. These tests were performed on uncut cores, which were then cut for comparison of the gapped and ungapped magnetic properties. The optimum transformer was found to be that with the lowest residual flux and a small amount of air gap in the magnetic material. The data obtained from these tests are described, and the potential uses for the materials are discussed. Author

N72-11229*# Westinghouse Electric Corp., Linthicum Heights, Md.
**PHOTOTRANSISTOR Patent Application**
David H. McCann, inventor (to NASA) Filed 19 Feb. 1971 12 p Sponsored by NASA
(NASA-Case-MFS-20407; US-Patent-Appl-SN-116777) Avail: NTIS CSCL 09A

A phototransistor is described that includes as a part of its integral structure an auxiliary diode in the form of an added base-collector junction. The diode is formed in the surface of the base element out of the direct path between the emitter and collector regions of the phototransistor. NASA

N72-11230*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**HALL EFFECT TRANSDUCER Patent Application**
David L. Smith, inventor (to NASA) Filed 19 Mar. 1971 7 p
(NASA-Case-LAR-10820-1; US-Patent-Appl-SN-125979) Avail: NTIS CSCL 09E

A Hall effect transducer that produces output voltages directly proportional to rotary shaft displacements is reported. The linearity of this transducer is extended to a range of input

shaft rotation up to + or - 50 degrees by means of a special Hall probe. NASA

**N72-11231*#** Texas Instruments, Inc., Dallas.
**INTEGRATED CIRCUIT INCLUDING FIELD EFFECT TRANSISTOR AND CERMET RESISTOR Patent Application**
George Axel Brown and Victor Harrad, inventors (to NASA) Filed 19 Feb. 1971 14 p
(Contract NAS5-10307)
(NASA-Case-GSC-10835-1; US-Patent-Appl-SN-116778) Avail: NTIS CSCL 09A

A single integrated circuit chip is described which includes a field effect transistor with an insulating layer of silicon nitride covering the interface between a silicon substrate and a silicon oxide layer. A thin film cermet resistor on the nitride layer is connected to an ohmic contact of a field effect transistor electrode. NASA

**N72-11232*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**FAMILY OF FREQUENCY TO AMPLITUDE CONVERTERS Patent Application**
Carrington H. Stewart, inventor (to NASA) Filed 16 Apr. 1971 32 p
(NASA-Case-MSC-12395-1; US-Patent-Appl-SN-134573) Avail: NTIS CSCL 09E

A family of frequency-to-amplitude converters is disclosed. These convert an incoming signal of complex waveform and unknown frequency into an output signal corresponding in amplitude to the unknown frequency of the input signal. Thus an accurate determination of the frequency of the complex input signal waveform can be made. NASA

**N72-11233#** California Univ., Berkeley. Lawrence Radiation Lab.
**OPTICAL METHODS FOR THE STUDY OF CONVECTIVE MASS TRANSFER BOUNDARY LAYERS ON EXTENDED ELECTRODES**
Kirk Watson Beach Jun. 1971 177 p refs
(Contract W-7405-eng-48)
(UCRL-20324) Avail: NTIS

Several optical techniques have been combined for the study of mass transfer boundary layers along extended horizontal electrodes in rectangular ducts. A Mach-Zehnder interferometer, supplemented by a focussing critical angle refractometer is used to determine the concentration boundary layer profiles as a function of the distance from the leading edge of the electrode with a consideration of the variation in the cross channel direction. A laser velocimeter is included in the system for the measurement of the electrolyte velocity near the electrode as a function of time and position. A numerical analysis of light propagation in the nonuniform refractive index fields found in mass transfer boundary layers has shown that the previously used expressions for computing concentration profiles from interferometer fringe patterns often result in large errors in boundary layer dimensions and concentrations. A method for deriving concentration profiles from interferometer fringe patterns with a consideration of light deflection distortions is presented. Author (NSA)

**N72-11234#** Sandia Corp., Albuquerque, N.Mex. Electronic Devices Test Development Div.
**PROGRAMMING SEMICONDUCTOR TEST SYSTEMS TO MEASURE CONTROLLED RECTIFIERS**
Richard G. Bemis Apr. 1971 24 p refs Sponsored by AEC
(SC-M-70-887) Avail: NTIS

The method for setting up the Fairchild 4000 and Teradyne T217 semiconductor testers to measure characteristics of a silicon-controlled rectifier is reported. The test circuits and the programming required are described in detail to enable the reader to prepare similar device test programs. Author (NSA)

**N72-11235#** Naval Research Lab., Washington, D.C. Space Systems Div.
**VHF ANTENNAS FOR LOW ALTITUDE SATELLITES Interim Report**
Stephen Nichols 12 Jun. 1971 65 p refs
(AD-727572; NRL-7292) Avail: NTIS CSCL 09/5

Two vhf satellite antennas are discussed in depth. The first is a turnstile antenna, which is presented with theory, computer calculations, experimental results, and two novel applications. The first application solves the problem of interfering solar cell panels by combining them with the antenna. The second application puts the turnstile antenna on a boom away from the satellite to minimize interference. The second vhf satellite antenna presented has multiple elements and is designed to optimize the pattern with respect to the distance and angle from a stabilized satellite to a ground station as it passes overhead. This antenna was found to have a 3-dB improvement over the best turnstile designs. Author (GRA)

**N72-11236#** Cornell Univ., Ithaca, N.Y. Materials Science Center.
**STABLE SUPERCONDUCTING POINT CONTROL WEAK LINKS**
Robert A. Buhrman, Stephan F. Strait, and Watt W. Webb 12 May 1971 8 p refs
(Contract N00014-67-A-0077-0016; NR Proj. 319-032)
(AD-724791; MSC-1555; TR-3) Avail: NTIS CSCL 14/2

Mechanically stable, room-temperature-helium-temperature-cyclable insulated double and single point contacts have been obtained by use of an insulating glass with thermal expansion matching that of the niobium superconductor. When two of these contacts are connected in parallel, the resultant device works quite well as a cyclable dc-biased magnetometer. Author (GRA)

**N72-11237#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**A MINIATURE KINESCOPE**
Ye. S. Geizler 26 Feb. 1971 9 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya (Moscow), no. 3, 1970 p 64-65
(AD-725014; FTD-MT-24-336-70; UR/0187-70-000-003; T65-05-25) Avail: NTIS CSCL 09/1

A miniature kinescope was constructed completely of glass. The screen is flat and has been aluminized; it has a diameter of 30 mm, and the neck diameter is 13 mm. The length of the kinescope is 80 mm; its weight is 15 g. Ray focus is electrostatic; deflection is electromagnetic. The deflection angle is 60 degrees. Author (GRA)

**N72-11238#** Naval Postgraduate School, Monterey, Calif.
**DESIGN AND PERFORMANCE OF A MULTIPLE-LOOP FREQUENCY SYNTHESIZER**
Harley J. Holliday and Glen A. Myers May 1971 68 p refs
(AD-725141; NPS-52MV71051A) Avail: NTIS CSCL 09/5

The report presents the results of the design and fabrication of a Multiple-Loop Frequency Synthesizer. The design utilizes frequency control loops to extend the capture range of a phase-locked loop used to provide frequency stability. No harmonic generators, mixers, or filters are used, in the usual sense; a single crystal oscillator is required. The synthesizer is small, light weight, accurate to within plus or minus 0.0025% of the programmed frequency, covers the AM broadcast band (500 kHz to 1600 kHz), and is electronically tunable in 10 kHz steps. Unwanted sidebands 5 kHz and 10 kHz away from the programmed frequency have relative magnitudes of -28 db and -40 db, respectively. Author (GRA)

**N72-11239#** Innsbruck Univ. (Austria). VLF Project.
**VLF/LF ANTENNAS AND WAVES IN LIQUID AND SOLID MEDIA Final Scientific Report**
Ch. Grissemann, R. Klein, N. Nessler, M. Wieser, and H. Woebking 31 Dec. 1970 115 p refs

(Contract F61052-69-C-0007)
(AD-725768; AFCRL-71-0197) Avail: NTIS CSCL 09/5

In the present report some considerations have been made regarding the calibration of ferrite antennas. It has thus proved possible to make calibrations even in the extreme near field of the transmitting coil. Optimum noise matching of the ferrite antenna to the antenna preamplifier via a transformer is calculated. For determining the electric rock parameters, a new and improved method by wave propagation is suggested. The studies on the helical antennas and on the phase synchronization measuring device are being continued. The intermediate results are given in the present report. The geophysical section is concerned with producing and measuring samples of definite properties and with some theoretical considerations on rock parameters. Author (GRA)

N72-11240# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
**ANALYSIS AND DESIGN OF ARRAYS OF LOADED THIN WIRES BY MATRIX METHODS**
Kazuhiro Hirasawa and Bradley J. Strait 15 May 1971 128 p refs
(Contract F19628-68-C-0180; AF Proj. 5635)
(AD-725767; AFCRL-71-0296; SR-12; Task-563508) Avail: NTIS CSCL 09/5

Analysis and design of arrays of thin straight-wire antennas and scatterers, both loaded and unloaded, are considered. Solutions are obtained by matrix methods applied to the integro-differential equation which characterizes problems of this kind. It is shown that once the array geometry and the positions of any feed points are known both scattering and radiation problems can be handled through appropriate matrix manipulations. Linear problems in array design are discussed along with examples involving pattern synthesis and gain maximization. Nonlinear problems in array design by a gradient method are also included incorporating examples in the areas of sidelobe reduction, gain maximization, and feed system determination.
Author (GRA)

N72-11241# Pennsylvania State Univ., University Park. Materials Research Lab.
**CONTACTS BETWEEN CHALCOGENIDE GLASSES, METALS AND SEMICONDUCTORS Semiannual Technical Report**
H. K. Henisch 1 Jun. 1971 69 p refs
(Contract DAHC04-70-C-0047; ARPA Order 1562)
(AD-725487) Avail: NTIS CSCL 20/12

The two main purposes of the research here described are to elucidate the mechanism of threshold switching and to explore new possibilities through the use of contact materials which can be electronically altered in situ. In pursuit of these objectives, four lines of research have been followed. They are concerned with the nature of the ON-state, the effect of semiconductor electrodes and contact asymmetry on the switching process, the statistical nature of threshold switching, and scaling problems, i.e. the variation of switching parameters with thickness of the chalcogenide glass film. GRA

N72-11242# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
**ON THE HEAT BUDGET OF A BEAD THERMISTOR AT LOW PRESSURE AND SUBSONIC VELOCITY Final Report, 1 Mar. 1968 - 31 Mar. 1971**
Donald Lee Joseph 31 Mar. 1971 127 p refs
(Contract F19628-68-C-0210)
(AD-726115; AFCRL-71-0205) Avail: NTIS CSCL 09/1

Thermal interactions between the atmosphere and a falling rocket-sonde bead thermistor lead to significant errors in the indicated air temperature. In the same way the bead thermistor interacts with its support. Tests were made inside a vacuum bell jar where bead thermistors and support posts were mounted in two orientations on a whirling arm. These tests were made at lbw subsonic motion in a free molecule flow at 2.0 and 30.0 microfs of mercury pressure. Author (GRA)

N72-11243# Hughes Research Labs., Malibu, Calif.
**ELECTRON PHYSICS RESEARCH Quarterly Report, 1 Jan. - 31 Mar. 1971**
K. J. Russell and R. E. Lundgren Jun. 1971 69 p refs
(Contract DAAB07-70-C-0232; DA Proj. 1H6-62705-A-055-02-60)
(AD-725991; ECOM-0232-3; QR-3; Task-1116-62705-A-055-02-60) Avail: NTIS CSCL 09/1

The feasibility of combining the EBIRD electron beam ionization of semiconductor operating principle with avalanche diode operation was investigated. As a result of this investigation, a new mode of avalanche diode operation which combines EBIRD and TRAPPAT is proposed and a simple analytical theory for its operation is presented. Author

N72-11244# Army Electronics Command, Fort Monmouth, N.J. Electronic Components Lab.
**A 1.5-KW SOLID STATE POWER CYCLER**
Gregory J. Malinowski Apr. 1971 18 p refs
(DA Proj. 1H6-62705-A-056)
(AD-726018; ECOM-3410; OSD-1366) Avail: NTIS CSCL 14/2

The report describes the design and operation of a solid-state power cycler used in the evaluation of plastic encapsulated semiconductor devices. The cycler can switch loads up to 2.0 kW with a variable duty cycle. This report also shows the performance of the cycler as designed and recommends future modifications for added versatility. Author (GRA)

# 10 ELECTRONICS

Includes circuit theory, and feedback and control theory. For applications see 09 Electronic Equipment. For related information see specific Physics categories.

N72-11245 City Univ. of New York.
**DESIGN OF NONLINEAR CONTROL SYSTEMS VIA A TIME DOMAIN RATIO CRITERION Ph.D. Thesis**
Patrick Peruo, Jr. 1970 228 p
Avail: Univ. Microfilms Order No. 70-19553

An investigation is presented of the quantitative properties of Liapunov functions. A design method is developed which utilizes these quantitative properties. The design method is applicable to high order nonlinear autonomous systems containing inherent nonlinearities. The nonlinearities may be of the multiplicative type and/or expressible as general polynomials of the system side variables. The objective of the design method is to formulate a controller for a system so that the equilibrium solution of the system augmented with the controller will be asymptotically stable and the domain of attraction contains a given initial condition. It is also required that the magnitude of the deviation of the output of the augmented system from its equilibrium value, due to the given initial condition, be less than a specified value for all time greater than a specified time. The design method is illustrated and analyzed via illustrative examples. Dissert. Abstr.

N72-11246 California Univ., Los Angeles.
**INSTABILITY THRESHOLDS IN DIGITAL FILTERS Ph.D. Thesis**
Robert Keith Otnes 1970 160 p
Avail: Univ. Microfilms Order No. 70-19876

An expression is developed to determine the threshold frequency at which certain digital lowpass recursive filters become unstable. Both floating point and fixed point arithmetic is considered. The theoretical threshold values are compared with those obtained through actual operation of the filter on data. Dissert. Abstr.

**N72-11247** New York Univ., N.Y. School of Engineering and Science.
**COMPUTER-AIDED DESIGN OF DISTRIBUTED RC NETWORKS USING ORTHAGONAL FUNCTIONS Ph.D. Thesis**
Sueleyman Sirri Penbeci 1969 124 p
Avail: Univ. Microfilms Order No. 70-9786

A synthesis method of uniform and tapered distributed RC networks using orthogonal functions and nonlinear programming is investigated. First, an analytic distributed RC network approximate synthesis method using a class of orthogonal functions is introduced to approximate given network functions. Then, the approximating function obtained is used as an initial design and the nonlinear minimization programming is applied to minimize tye ISE between the given function and the initial approximating function in the finite frequency range of interest. The iterative minimization procedure used is guaranteed to converge to a minimum, within a reasonably short computing time. Dissert. Abstr.

**N72-11248** California Univ., Berkeley.
**OPTIMAL DESIGN OF NONLINEAR AND TIME-VARYING NETWORKS AND SYSTEMS Ph.D. Thesis**
Behrouz Peikari 1969 95 p
Avail: Univ. Microfilms Order No. 70-17640

The optimal design of linear time-varying networks and the design of nonlinear time-invariant networks to be operated in the small-signal mode are considered. In the first part, the small signal analysis of nonlinear networks with slowly-varying bias sources is studied. A frozen operating point is defined and it is shown that small signal analysis about the frozen operating point is correct within higher order terms in the small signal provided a correction term is inserted in the linearized equation. The second part considers the optimal design of linear time-varying networks. A quadratic performance criterion is formulated and the design is obtained iteratively using steepest descent in function space. The last part considers the design of a nonlinear time-invariant network with variable bias sources whose small signal equivalent network is identical with a given linear time-varying network. Dissert. Abstr.

**N72-11249** Southern Methodist Univ., Dallas, Tex.
**A FIXED CONFIGURATION APPROACH TO STOCHASTIC CONTROL Ph.D. Thesis**
Craig Stephen Sims 1970 103 p
Avail: Univ. Microfilms Order No. 70-19258

Stochastic optimal control theory has developed, to a large extent, within the framework of dynamic programming, with optimization depending on all the information available. A study of the optimal and suboptimal control of continuous time systems is presented, which is described by formal or rigorous stochastic differential equations. The fixed configuration approach is an alternative method of solving stochastic control problems. A general two-point boundary value problem formulation was developed for a large class of stochastic optimization problems under a variety of control structure specifications. The application of the fixed configuration technique to the stochastic linear regulator problem and a class of stochastic nonlinear regulator problems was investigated. The pratical importance of the technique is due primarily to the limited complexity of the control structure that the designer specifies. The method also has merit in that one may use it to obtain a suboptimal controller for systems that have no known optimal solution.
Dissert. Abstr.

**N72-11250** Pittsburgh Univ., Pa.
**SOME ASPECTS OF THE DESIGN OF NONLINEAR FEEDBACK SYSTEMS Ph.D. Thesis**
Matthew Siman 1969 252 p
Avail: Univ. Microfilms Order No. 70-16363

A study was made to develop design procedures that do not require a large computational effort. Three design procedures are presented. The first procedure permits the design of a cascade compensator such that the compensated system satisfies the specification on the steady state error, the decay rate of the response bound, and the sector of stability. The second procedure has as its objective the design of a feedback compensator H(s) such that a specification on the response of one of the system's variables due to a disturbance is satisfied. At the heart of this design procedure is the shaping of the transfer function G(jw)H(jw) which is the transfer function of the linear part of the nonlinear feedback system. The third design procedure permits the determination and implementation of a control law which minimizes the bound on the performance index of a nonlinear feedback system. All of the design procedures are illustrated by the use of examples. Dissert. Abstr.

**N72-11251** Purdue Univ., Lafayette, Ind.
**NOISE FIGURE AND GAIN OF LINEAR NETWORKS CONTAINING A SINGLE SINUSOIDALLY VARYING ELEMENT Ph.D. Thesis**
Daryl Darwin Thornburg 1970 132 p
Avail: Univ. Microfilms Order No. 70-18755

A method is presented for determining the noise figure and gain for general classes of time varying linear systems containing a single sinusoidally varying element. These results are obtained for a general parametric amplifier employing a circulator and a general three-port frequency converter. The generality of the system is obtained by utilizing a scattering matrix representation of these systems. The voltage-current relationships within the system are determined by the solution of a second order difference equation. The difference equation results from the frequency domain representation of the integral-differential system equation. Numerical examples comparing these exact calculations with the two frequency methods of harmonic balance are given. Both the parametric amplifier and frequency converter are included in these comparisons. Design criteria resulting from these examples are given. The conditions that are necessary for harmonic balance methods to yield satisfactory gain and noise figure for these general systems are also discussed.
Dissert. Abstr.

**N72-11252** Purdue Univ., Lafayette, Ind.
**ERROR BOUNDS FOR THE DUAL INPUT DESCRIBING FUNCTION TECHNIQUE Ph.D. Thesis**
Larry Owen Taylor 1970 108 p
Avail: Univ. Microfilms Order No. 70-18749

Error bounds on the solution obtained by application of the dual input describing function to forced oscillating systems are obtained for several classes of nonlinearities. Nonlinear feedback systems described by differential equations are considered in the analysis. The basic method involves transforming the system differential equation into an integral equation to obtain estimates of the magnitude of the harmonic content of the system response and the absolute error in the describing function approximation. Some of the classes of nonlinearities for which results were obtained are those that are bounded, slope limited, sector constrained, Lipschitz constrained, and cubic. Examples of the sector constrained and the cubic types of nonlinearities are presented. Frequency response curves obtained with the describing function method are presented for the examples with cubic nonlinearities in addition to the error bounds computed for specific inputs. Dissert. Abstr.

**N72-11253** Purdue Univ., Lafayette, Ind.
**MODELING OF DYNAMIC HYSTERESIS LOOPS Ph.D. Thesis**
Keith Allan Stromsmoe 1970 127 p
Avail: Univ. Microfilms Order No. 70-18743

The problem of finding a general hysteretic model useful for simulation studies is investigated. A first order differential equation is proposed as a model. It has the capability of representing the two basic mechanisms of energy dissipation and energy storage. The model is shown to have the following properties: the solution is unique, a bounded input results in a bounded output, and a periodic input signal gives rise to a

unique periodic response signal, which results in closed hysteresis loops. The area of such closed loops is shown to increase as the excitation frequency increases. A construction procedure is presented so that the model can be determined from a given hysteresis loop. A simplified form of the equation is shown to be a useful model for simulating iron-core inductors and transformers. This model has a simple circuit interpretation which allows conventional circuit analysis techniques to be employed. Two examples are considered to demonstrate the utility of the model. Dissert. Abstr.

N72-11254 British Broadcasting Corp., Kingswood (England). Research Dept.
**FIELD STORE STANDARDS CONVERSION: EQUALIZERS FOR ULTRASONIC QUARTZ DELAY LINES**
R. V. Harvey 1971 8 p refs
(BBC-1971/36) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A field-store standards converter has been built which uses fused quartz delay lines as the storage medium for the television signal. The associated amplifiers contain equalizers which allow the gain and group-delay to be adjusted so that the overall delay-unit response lies between very close, specified limits. The report describes the design and adjustment of a novel form of active equalizer and the development for the detailed examination of the responses of the duty-unit. Author

N72-11255 British Broadcasting Corp., Kingswood (England). Engineering Div.
**FIELD STORE STANDARDS CONVERSION: THE FIELD-STORE SYNCHRONISER**
D. W. Osborne and A. Roberts 1971 9 p refs
(BBC-1971/38; UDC-621.397.63:621.377) Avail: BBC, Kingswood Warren, Tadworth Surrey, England

The need for synchronizing television signals from various sources is discussed and an outline description is given of the adaptation of the BBC C08/508 field-store standards converter to operate alternatively as a television source synchronizer. Certain special features of the principle of operation are discussed in greater detail. Author

N72-11256* Stanford Univ., Calif.
**ACTIVE RC NETWORKS Patent**
William J. Kerwin and Charles V. Shaffer, inventors (to NASA) Issued 13 Jul. 1971 8 p Filed 8 May 1970 Continuation of abandoned US Patent Appl. SN-751265, filed 8 Aug. 1968 Sponsored by NASA
(NASA-Case-ARC-10042-2; US-Patent-3,593,175; US-Patent-Appl-SN-33159; US-Patent-Class-330-107; US-Patent-Class-330-109) Avail: US Patent Office CSCL 09C

An active RC network formed by a voltage amplifier and a passive RC feedback network connected in a negative feedback loop with the amplifiers is described. The negative feedback network is able to receive a resistance such that when the resistance is zero, there are no zeros in the transmission of the feedback network (phantom zeros), and when the resistance is finite, there are complex conjugate phantom zeros in the right half of the complex frequency plane. For any given value of the quality factor Q of the network response, both the required amplifier gain and the sensitivity of the circuit to gain and component changes are small, with the value of the phantom-zero-determining resistance being selected to achieve a desired trade-off between the values of the gain and the sensitivity. In certain embodiments, the passive RC network includes a distributed RC element in which the resistive portion of the distributed element is connected between the output and input of the voltage amplifier.
Official Gazette of the U.S. Patent Office

N72-11257*# Massachusetts Inst. of Tech., Cambridge. Electronics Systems Lab.
**OPTIMAL LINEAR TRACKING SYSTEMS M.S. Thesis**
Nils R. Sandell, Jr. Sep. 1971 62 p refs Supported in part by Bell Telephone Labs.
(Grants NGL-22-009-124; AF-AFOSR-194-70; NSF GK-25781) (NASA-CR-123318; ESL-R-456) Avail: NTIS CSCL 17H

The problem of the design of linear, time-invariant tracking systems is considered. The concept of a type-I system is generalized from single-input, single-output systems to m-input, m-output systems. A technique is presented for the design of a linear tracking system that has an optimal step response. The properties of the design are illustrated by a computer simulation.
Author

N72-11258*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SILENT EMERGENCY ALARM SYSTEM FOR SCHOOLS AND THE LIKE Patent Application**
William S. Read and Vasel W. Roberts, inventors (to NASA) Filed 6 Aug. 1971 21 p
(Contract NAS7-100)
(NASA-Case-NPO-11307; US-Patent-Appl-SN-169671) Avail: NTIS CSCL 09C

An emergency alarm system is disclosed for use in schools. In the school each classroom (or other area) is instrumented with a hidden microphone and a receiver tuned to a non-audible frequency. The receivers' outputs are connected to a central display unit in the school's administrative office. Each instructor is provided with a small concealable transmitter which, when hand activated by the instructor upon the occurrence of any emergency, generates a non-audible signal at the receiver's tuned frequency. NASA

N72-11259*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**APPARATUS AND METHOD FOR STATISTICAL TIME SERIES ANALYSIS OF ELECTRICAL SIGNALS Patent Application**
Carrington H. Stewart, inventor (to NASA) Filed 11 Aug. 1971 36 p
(NASA-Case-MSC-12428-1; US-Patent-Appl-SN-170881) Avail: NTIS CSCL 09C

A device is described for performing statistical time-series analysis of complex electrical signal waveforms, permitting prompt and accurate determination of statistical charactertistics of the signal. Simple, rapid, and accurate analysis of complex electrical signal waveforms are performed by determining the difference between the instantaneous frequency and the average frequency of the signal, and by generating statistical moments regarding such difference. Statistical moments are formed by raising the difference between the instantaneous frequency and the average frequency to the second, third, fourth, and higher powers. NASA

N72-11260# California Univ., Livermore. Lawrence Radiation Lab.
**PSEUDO-DERIVATIVE-FEEDBACK (PDF) CONTROL**
Richard M. Phelan (Cornell Univ., Ithaca, N. Y.) 9 Apr. 1971 51 p refs
(Contract W-7405-eng-48)
(UCRL-51036) Avail: NTIS

The recently developed pseudo-derivative-feedback (PDF) control algorithm is shown to be superior to all traditional linear algorithms by comparing the response of the several systems in selected situations that cover all applications of feedback control systems. The common denominator for determining numerical values of the several parameters is that the maximum energy-delivering capability of the system is utilized at some time during the response to a given magnitude step change in reference input. PDF control is shown to provide (1) the stiffest system, (2) the least sensitivity to disturbances such as a change in load on the controlled system, (3) a step response without overshoot for both first- and second-order controlled systems, (4) the flattest frequency response and maximum bandwidth, and (5) the simplest tuning procedure for determining the values of

parameters required to optimize the response characteristics of given system. NSA

**N72-11261#** Bendix Corp., Kansas City, Mo.
**ELECTRONIC ENGINEERING QUARTERLY**
Jun. 1971 227 p refs
(Contract AT(29-1)-613)
(BDX-613-431; UC-38) Avail: NTIS

The tests carried out and the results obtained for various electronic assemblies, are given. Data include aluminum pulse arc welding, leak detection in hermetically sealed assemblies, elimination of insulation resistance failures in Ablefoam encapsulated assemblies, techniques for obtaining precision pulse current viewing resistors, devices for computer controlled assemblies, diagnosing malfunctions in complex electronic assemblies, and application of flow soldering techniques to fabricating printed wiring boards. E.H.W.

**N72-11262#** Rice Univ., Houston, Tex. Aero-Astronautics Group.
**COMPARISON BETWEEN VARIOUS GRADIENT ALGORITHMS IN CONTROL THEORY. PART 1: SEQUENTIAL GRADIENT-RESTORATION ALGORITHMS**
Robert E. Prichard Jun. 1971 13 p refs
(Grant AF-AFOSR-828-67; AF Proj. 9769)
(AD-725048; AAR-96-Pt-1; AFOSR-71-1746TR-Pt-1) Avail: NTIS CSCL 12/1

Two different approaches to the formulation of sequential gradient-restoration algorithms in control theory are compared. The viewpoints compared are those of Miele and Kelley. Each derivation is presented separately and is applied to the simplest problem of the calculus of variations, that of minimizing a line intergral, the endpoints being fixed. It is concluded that Miele's viewpoint is conceptually simpler, and the resulting algorithm is easier to implement than Kelley's algorithm. Also, the control change is optimum in Miele's algorithm, whereas this is not the case in Kelley's algorithm. Author (GRA)

**N72-11263#** Rice Univ., Houston, Tex. Aero-Astronautics Group.
**COMPARISON BETWEEN VARIOUS GRADIENT ALGORITHMS IN CONTROL THEORY. PART 2: COMBINED GRADIANT-RESTORATION ALGORITHMS**
Robert E. Pritchard Jun. 1971 27 p refs
(Grant AF-AFOSR-828-67; Proj. AF-9749)
(AD-725047; AAR-97-Pt-2; AFOSR-71-1745TR-Pt-2) Avail: NTIS CSCL 12/1

Two different approaches to the formulation of combined gradient-restoration algorithms in control theory are compared. The viewpoints compared are those of Miele and Bryson. Each derivation is presented separately and is applied to the simplest problem of the calculus of variations, that of minimizing a line integral, the endpoints being fixed. It is concluded that Miele's viewpoint is conceptually simpler, and the resulting algorithm is easier to implement than Bryson's algorithm. Author (GRA)

**N72-11264#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PROGRESS IN ELECTRONIC MINIATURIZATION**
V. A. Kotelnikov 29 Jan. 1971 11 p Transl. into ENGLISH from Pravda, Moscow (USSR), 7 May 1970 p 6
(AD-725002; FTD-HT-23-73-71) Avail: NTIS CSCL 09/2

A discussion is given of two problem areas of fundamental importance: the imperative need to move to increasingly shorter wavelengths, through the millimeter and submillimeter bands down to fractions of microns in the laser range, and, secondly, the miniaturization of electronic components, particularly as they relate to such applications as computer storage systems. GRA

**N72-11265#** Virginia Univ., Charlottesville. Research Labs. for the Engineering Science.
**LEARNING CONTROL SYSTEMS AND PATTERN RECOGNITION Annual Progress Report, 15 Sep. 1969 - 14 Sep. 1970**
J. W. Moore, E. S. McVey, R. L Ramey, E. A. Parrish, Jr., R. A. Smoak, and E. J. White May 1971 288 p refs
(Contract DAAB07-68-C-0066; DA Proj. 1T0-61102-b-81-A; Proj. Themis)
(AD-725579; THEMIS-3375-150-70U; ECOM-0066-4; OSD-1366) Avail: NTIS CSCL 09/4

The report covers progress in the third year on a Project THEMIS contract for research in Learning Control Systems and Pattern Recognition. Topics covered include academic progress, system stability studies, learning systems, digital predictive compensation, resolution improvement in pattern recognition systems, photoptic receptor systems, and thin film diode research. The report is divided into four sections. The first section covers academic progress. It reports on new courses developed as a result of the research program, on graduate degrees obtained and on publications in the technical literature of research results. Section II reports on progress in three areas under learning control systems. The first area involves studies of man as a learning controller. The second area concerns ideal prediction with a learning system. The third area is the stability of learning control systems. Section 3 reports on progress in the pattern recognition area. Topics covered are: A mechanization of the McVey-McRee sequential enhancement scheme; Use of adaptive threshold elements for image boundary enhancement; Signal perturbation theory; A priori error estimates for certain classes of pattern recognition machines. Section 4 reports on progress in the development of photosensitive receptor systems. Research has been done on the use of fiber optic methods for converting from video information to electronic information. The Evans Laboratories have been very cooperative in producing integrated photodiode arrays for our use. Author (GRA)

**N72-11266#** University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
**ADAPTIVE AND OPTIMUM CONTROL OF DYNAMIC SYSTEMS Final Technical Report**
L. W. Neustadt Jun. 1971 15 p refs
(Grant AF-AFOSR-1029-67; AF Proj. 9749)
(AD-726130; AFOSR-71-1868TR) Avail: NTIS CSCL 12/1

The report is a summary of research activities involving the problems of stochastic control. One of the accomplishments has been the development of a general theory of necessary conditions for optimization problems. Author (GRA)

**N72-11267#** Army Missile Command, Redstone Arsenal, Ala.
**EXPERIMENTAL STUDY OF DISTURBANCE ABSORBING CONTROLLERS**
William W. Malcolm Jun. 1971 159 p refs
(AD-726022; RG-TR-71-8) Avail: NTIS CSCL 12/1

An experimental study was performed to determine practical design considerations for applying the theory of disturbance absorbing controllers to some typical regulator type control systems. The systems considered were subjected to a variety of typical disturbances encountered in practice and the effectiveness of the absorber was evaluated for various controller characteristics. A brief summary of the mathematical theory of disturbance absorbing controllers is presented and a step-by-step procedure for the practical designing of disturbance-absorbing controllers is developed. Author (GRA)

**N72-11034#** LTV Aerospace Corp., Dallas, Tex.
**PROJECTED MAINTAINABILITY ADVANTAGES OF SOLID STATE ELECTRICAL POWER MANAGEMENT AND SOLID STATE CONTACTLESS SWITCHING SYSTEMS**
T. S. Miller *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 31 p refs (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95



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# 11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-11268 National Lending Library for Science and Technology, Boston Spa (England).
**THE BABAR EJECTOR SYSTEM, AN EXPERIMENTAL FACILITY FOR THE HIGH-TEMPERATURE IRRADIATION OF FUEL IN A HELIUM ATMOSPHERE**
M. Nogues, J. C. Nervi, and M. Vidard 7 Sep. 1971 28 p Transl. into ENGLISH of CEA report MN/JCN/-MVI/CV-70/113 (1970)
(NLL-LB/G/2978-(9091.9F); LB/G/2978) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

A coolant temperature stabilized at more than 1000 C was attained in experimental reactors; the thermal energy was derived entirely from nuclear origin and supplied by a prismatic fuel element of the HTR. The Babar ejector system was used for in-pile and out-of-pile fuel tests in a helium atmosphere. J.A.M.

N72-11269*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**VARIATION IN SPECTRAL IRRADIANCE OF THE SES SOWAR SIMULATOR**
Arthur E. McNutt Apr. 1971 18 p
(NASA-TM-X-65734; X-322-71-194) Avail: NTIS CSCL 14B

A test to determine the spectral characteristics of the solar simulation produced by the solar environment simulator (SES) comprised a statistical analysis to determine the spectral variance, and its effect on the average absorptivity of surface coatings. Author

N72-11270*# TRW Systems Group, Redondo Beach, Calif.
**FAST RESPONSE SOLAR ARRAY SIMULATOR Final Report, 25 Jun. - 25 Oct. 1968**
David W. Zerbel [1971] 63 p refs
(Contract NAS5-11581)
(NASA-CR-123319) Avail: NTIS CSCL 14B

Tradeoff studies to determine the design requirements for a fast response solar array simulator capable of delivering output power in the range of 20 to 5000 watts are reported. The studies were divided into four major areas: frequency and transient response considerations, digital versus analog characteristic generation and programming, optimum power module size, and accuracy considerations. Based on an evaluation of the tradeoffs, a reference design was selected with a forward biased solar cell as an analog reference, and with current accuracy of + or - 0.5% of the short circuit setting. F.O.S.

N72-11271*# McDonnell-Douglas Co., St. Louis, Mo.
**COLLAPSIBLE PISTONS Patent Application**
Robert N. Teng, inventor (to NASA) Filed 27 Jul. 1971 14 p Sponsored by NASA
(NASA-Case-MSC-13789-1; US-Patent-Appl-SN-166487) Avail: NTIS CSCL 14B

The design, characteristics, and operation of a collapsing piston for use in a shock tube are discussed. The difficulties in maintaining optimum pressure within a shock tube following puston motion are described. It is shown from time/history diagrams that the collapsing piston technique wil provide a constant pressure environment within the shock tube. P.N.F.

N72-11272# European Space Research and Technology Center, Noordwijk (Netherlands).
**DYNAMIC BEHAVIOUR OF THE PHOTOELECTRON SHEATH, PART 1**
R. J. L. Grard Paris ESRO Dec. 1970 41 p refs
(ESRO-SN-112(ESTEC)) Avail: NTIS

The electrical properties of the medium surrounding an interplanetary probe, or a celestial body without atmosphere, are modified by the presence of a photoelectron sheath. In a preliminary study of the dynamic behavior of this sheath, the velocity distribution of the photoelectrons was taken as monokinetic, the geometry of the probe was planar and the effect of a tenuous ambient plasma was neglected. The dynamic behavior of the sheath was simulated by means of a digital computer and was found to be unstable. The ways in which such an instability might interfere with the measurements made by the experimental packages on board the spacecraft are discussed. Author (ESRO)

N72-11273# European Southern Observatory, Hamburg (West Germany).
**[ACTIVITY REPORT OF THE EUROPEAN SOUTHERN OBSERVATORY] Annual Report 1969 [EUROPEAN SOUTHERN OBSERVATORY, RAPPORT ANNUEL 1969]**
1970 33 p In FRENCH
Avail: NTIS

The work carried out at the European Southern Observatory during 1969 including research projects and maintenance of equipment and buildings is reported. ESRO

N72-11274# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
**HIGH TEMPERATURE WITH SOLAR RADIATION Final Report on Materiel Test Procedure**
1 Jul. 1971 9 p refs Supersedes AD-718242
(AD-725522; MTP-5-593; AD-718242) Avail: NTIS
CSCL 14/2

Procedures are specified for simulating the effects of combined high temperature and solar radiation. Cause and effect relationships are discussed. Author (GRA)

N72-11685# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.
**CONTRIBUTION TO THE SELECTION OF FIRE EXTINGUISHING SYSTEMS AND AGENTS FOR AIRCRAFT FIRES**
R. Fiala *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 10 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11023# Boeing Co., Seattle, Wash.
**FACILITIES, EQUIPMENT AND TOOLS TO SUPPORT WIND BODIED AIRPLANE MAINTENANCE IN THE SEVENTIES**
M. Doyle *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 27 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

N72-11025# Automation Industries, Inc., Danbury, Conn. Materials Evaluation Group.
**NONDESTRUCTIVE INSPECTION: AN AIRCRAFT MAINTENANCE TOOL OF THE SEVENTIES**
Earl C. Mayes *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

N72-11156*# General Electric Co., Pittsfield, Mass. High Voltage Lab.
**LIGHTNING PROTECTION PRACTICES APPLIED TO FIELD STATION INSTALLATIONS**
Thomas J. Blalock and Edward R. Uhlig *In* NASA. Goddard

Space Flight Center Radio Freq. Interference Handbook 1971 p 199-253 refs (See N72-11153 02-07)
Avail: NTIS CSCL 14B

# 12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

**N72-11275** National Lending Library for Science and Technology, Boston Spa (England).
**TWO PHASE CRITICAL FLOW: EXAMINATION OF THE EIGEN-VALUE METHOD AND DETERMINATION OF THE CRITICAL FLOW SLIP RATIO**
Hideo Ogasawara Jul. 1971 25 p refs Transl. into ENGLISH from Nihon Kikai Gakkai Ronbunshu (Japan), v. 32, no. 240, 1966 p 1239-1248
(NLL-RTS-6242) Avail: Natl. Lending Library, Boston Spa, Engl: £ 2.40; 8 NLL photocopy coupons

A numerical analysis of critical point flow and a comparison of entropy and energy models to deduce the effect on the critical flow values are presented. The slip ratio at criticality is determined from correlated equations of motion. The energy method is employed to make an analysis of critical flow. Solutions of flow equations and mathematical models to depict flow conditions at criticality are included. Author

**N72-11276** National Lending Library for Science and Technology, Boston Spa (England).
**SWIRL AND ITS EFFECT ON THE FLAME**
S. Traustel 19 Aug. 1971 10 p Transl. into ENGLISH from VDI Ber. (Dusseldorf), no. 95, 1966 p 39-42
(NLL-CE-Trans-5566-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 7 NLL photocopy coupons

A combustible medium which leaves a burner either in a purely axial direction or with swirl is examined. The swirl-free flame is slim; with increasing swirl it becomes shorter and fuller, then cup-shaped and finally disc-shaped. Starting from the principles of fluid mechanics, the evaluation and measurement of swirl are discussed. Author

**N72-11277** National Lending Library for Science and Technology, Boston Spa (England).
**HYDRAULIC RESISTANCE IN A TWO PHASE FLOW**
A. V. Soloviev 1 Jun. 1971 11 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), v. 8, 1966 p 601-604
(NLL-NSTIC-Trans-2927-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Experimental data on hydraulic resistance of condenser tubes in conditions of the phases flowing in the same direction and opposite directions with constant wetting thickness, shows that the resistance of a two phase system has a number of pecularities which testify to the qualitative difference between this type of flow and the normal single phase flow. Thus, at a certain critical gas flow speed corresponding to the change from opposite flow to unidirectional flow, a sharp rise in resistance is observed. With further increase in speed of the gas phase the resistance falls, reaches a certain minimum value and then increases again. In this way every fixed wetting has a clearly defined minimum of fall of pressure. The existence of a flow region where with the increase of gas speed resistance falls seems at first sight to contradict natural laws. Author

**N72-11278** George Washington Univ., Washington, D.C.
**AN EXPERIMENTAL INVESTIGATION OF TURBULENCE EFFECTS AT THE SOLID BOUNDARY USING FLUSH MOUNTED HOT FILM SENSORS Ph.D. Thesis**
John Oreste Geremia 1971 172 p
Avail: Univ. Microfilms Order No. 70-19530

Hot film sensors were mounted flush to the wall of a 40 foot, honed, stainless steel pipe. Calibration in water was effected by measuring pressure drop with a linear variable differential transducer. Two models of sublayer theory were tested in the pipe. Strong support for the theory of Einstein and Li was found. Transposition of data from the time domain to the wave number domain reveals the surprising result of a nearly constant wave number, implying that the periodicity phenomenon is due to the same turbulence structure for all flow velocities. Data from further analysis of the random shear stress signals was compared with that obtained by hydrophones used in flow noise research. A comparison of the applicability and usefulness of the hot film over the hydrophone was made and the hot film was found to be at least a complementary device.
Dissert. Abstr.

**N72-11279** Washington Univ., Seattle.
**AN EXPLORATORY STUDY OF THE TURBULENT FREE CONVECTION FLOW ABOVE A HEATED HORIZONTAL CIRCULAR FLAT PLATE Ph.D. Thesis**
Tim Tse-Min Fu 1970 197 p
Avail: Univ. Microfilms Order No. 70-19623

The mean temperature fields and the indraft profiles for two mean plate temperatures were measured using a thermocouple and a constant temperature hot-wire anemometer. Also, the turbulence and mean velocity were measured for the higher plate temperature using the hot-wire method. The flow field was visualized by shadow photograph technique. From visualization and measurements, it was found that the region of significant deviation from ambient temperature and velocity was restricted to a region near the plate centering. The indraft velocity was found to be relatively large near the ground. The major temperature drop took place in the region very near the plate. Within 0.20' of the plate the temperature distribution in the air could be calculated based on conduction only. This region was therefore, called the conduction layer. At a given mean plate temperature, the temperature gradient was found to increase with the radius. Data obtained from heat transfer measurements were consistent with the one-third power correlation reported.
Dissert Abstr.

**N72-11280** Purdue Univ., Lafayette, Ind.
**A UNIFIED COMPARISON OF LOCAL AND GLOBAL TURBULENT SHEAR STRESS MODELS UTILIZED IN THE PREDICTION OF TWO DIMENSIONAL, INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS Ph.D. Thesis**
Victor George Forsnes 1970 337 p
Avail: Univ. Microfilms Order No. 70-18642

A critical and unified comparison of the various shear stress models (for incompressible, two-dimensional flow) was developed. The comparison is made both for these models themselves as descriptive of the shear stress distribution in a boundary layer, and for these models as they combine with a single mathematical technique to yield solutions of the appropriate boundary layer equations and thus provide a resulting prediction method. Over thirty global and local shear stress models proposed in the literature are compared with thirteen carefully selected experimental studies. This comparison between shear models did not involve any numerical solution techniques for solving the boundary layer equations themselves. On the basis of the resulting critique of the shear models, eleven different models were then incorporated into eleven different computation methods utilizing a single numerical technique for solving the resulting governing equations. The numerical calculations that resulted from these computation methods are then compared and a relative ranking of shear models is presented.
Dissert Abstr.

**N72-11281#** Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
**MIXING OF THERMAL MOLECULAR JETS PRODUCED**



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**FROM KNUDSEN EFFUSION**
T. Ytrehus, J. J. Smolderen, and J. F. Wendt Jun. 1971 24 p refs Presented at 3rd Symp. Intern. sur les Jets Moleculaires, Cannes, France, 29 Jun. - 2 Jul. 1971
(VKI-71-2) Avail: NTIS

The flow resulting from a mixture of a large number of thermal molecular jets in a region of finite pressure is studied. The theoretical problem is treated by a moment method based on a particular form of the molecular velocity distribution function. The analysis indicates that the resulting one-dimensional flow velocity can attain a slightly supersonic value. The velocity depends on only one parameter (the pressure-porosity parameter) which is naturally introduced into the calculation. In the non-equilibrium region near the plane containing the orifices, the gas experiences a one-dimensional expansion, accompanied by a slight reduction in temperature. The theoretical results concerning this region are confirmed by measurements of the molecular flux near the orifice plane. Author

N72-11282# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**TURBULENT BOUNDARY LAYER WITH INJECTION AT THE WALL OF THE SAME OR A DIFFERENT GAS [COUCHE LIMITE TURBULENTE AVEC INJECTION A LA PAROI D'UN MEME GAZ OU D'UN MEME GAZ OU GAZ ETRANGER]**
Taieb Lili and Roger Michel 1971 10 p refs In FRENCH; ENGLISH summary Presented at AGARD Meeting on Turbulent Stratified Flows, London, 13-15 Sep. 1971
(ONERA-TP-986) Avail: NTIS

An improved mixing length model was applied to the theoretical determination of the development of a turbulent boundary layer and comparison with experimental solutions relative to the influence of fluid transfer at the wall. The case considered is one in which injection is of a gas identical to that of the flow or of a foreign gas, for which there is complete absence of chemical reaction. Numerical solution of local boundary layer equations is possible for the general case with certain limiting conditions. Application of some experimental cases are presented using finite difference calculus. In the incompressible field, some solutions are provided for the local equations of an equilibrium boundary layer, in order to define the requisite set of velocity profiles and skin friction law for air injection with a pressure gradient. The velocity and concentration profiles were derived for foreign gas injection. The solution was extended to cover the general case of a compressible fluid. This led to a systematic set of results for the effect of injection upon skin friction and heat transfer as a function of Mach number and wall temperature. Author

N72-11283# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**STUDY OF CHEMICAL EVOLUTIONS IN HYDROGEN-AIR MIXING LAYER [ETUDE DES EVOLUTIONS CHIMIQUES DANS UNE COUCHE DE MELANGE HYDROGENE-AIR]**
Otto Leuchter 1971 4 p refs In FRENCH; ENGLISH summary Presented at the Colloq. of the French Phys. Soc., Evian, France, 25-29 May 1971
(ONERA-TP-981) Avail: NTIS

The confluence of two parallel flows of air and hydrogen is examined numerically to determine the conditions of ignition in the mixing layer. The calculations show the reaction zone to be limited to the stoichiometric region. For the two streams at the same temperature, the ignition length can be evaluated by neglecting the effects of lateral diffusion. Author

N72-11284*# Illinois Univ., Urbana. Aeronomy Lab.
**COMPUTER SIMULATION OF SUPERSONIC RAREFIED GAS FLOW IN THE TRANSITION REGION, ABOUT A SPHERICAL PROBE; A MONTE CARLO APPROACH WITH APPLICATION TO ROCKET-BORNE ION PROBE EXPERIMENTS Aeronomy Report No. 43**
B. E. Horton and S. A. Bowhill 1 Aug. 1971 121 p refs
(Grant NGR-14-005-013)
(NASA-CR-123315; Rept-43; UILU-ENG-71-2502) Avail: NTIS CSCL 20D

This report describes a Monte Carlo simulation of transition flow around a sphere. Conditions for the simulation correspond to neutral monatomic molecules at two altitudes (70 and 75 km) in the D region of the ionosphere. Results are presented in the form of density contours, velocity vector plots and density, velocity and temperature profiles for the two altitudes. Contours and density profiles are related to independent Monte Carlo and experimental studies, and drag coefficients are calculated and compared with available experimental data. The small computer used is a PDP-15 with 16 K of core, and a typical run for 75 km requires five iterations, each taking five hours. The results are recorded on DECTAPE to be printed when required, and the program provides error estimates for any flow field parameter. Author

N72-11285*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LIQUID TRANSFER DEMONSTRATION ON BOARD APOLLO 14 DURING TRANSEARTH COAST**
Kaleel L. Abdalla, Edward W. Otto, Eugene P. Symons, and Donald A. Petrash Washington Nov. 1971 31 p refs
(NASA-TM-X-2410; E-6481) Avail: NTIS CSCL 22C

The transfer of liquid from one container to another in a weightless environment was demonstrated by the crew of Apollo 14. A scale-model liquid-transfer system was used on board the spacecraft during the transearth coast period. The liquid transfer unit consisted of a surface tension baffled tank system containing two baffle designs. Liquid was transferred between tanks with a hand pump operated by the astronaut. The results showed that liquid was efficiently transferred to and from either baffled tank to within two percent of the design value residual liquid without reaching gas ingestion. The liquid-vapor interface in the receiver tank was positioned successfully with the gas located at the vent. Author

N72-11286*# Virginia Polytechnic Inst., Blacksburg. Dept. of Aerospace Engineering.
**TURBULENT JET MIXING IN A SUPERSONIC STREAM**
R. C. Swanson and J. A. Schetz Nov. 1971 58 p refs
(Contract NAS1-10233)
(NASA-CR-111981) Avail: NTIS CSCL 20D

An experimental study of turbulent, subsonic, coaxial jet mixing of air in a supersonic air stream is presented. Data taken at five axial stations downstream of the exit of the jet supply tube, which was suspended through the nozzle throat of a supersonic wind tunnel, are given in the form of total pressure, Mach number, and velocity distributions. An investigation of the effect of swirl as a mixing aid was conducted. Swirl, produced by tangential injection of 50% of the total air mass flow leaving the jet supply tube, was examined through Schlieren photographs and total pressure surveys. From a comparison of nonswirl and swirl data, it is concluded that the swirl has no discernible effect on the mixing. Author

N72-11287# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**NONLINEAR STABILITY THEORY OF LAMINAR FLOWS IN THE CASE OF EXCHANGE OF STABILITIES [THEORIE NON LINEAIRE DE LA STABILITE DES ECOULEMENTS LAMINAIRES DANS LE CAS DE L'ECHANGE DES STABILITES]**
Gerard Iooss 1971 11 p refs Presented at the 10th Biennal Fluid Dyn. Symp., Rynia, Poland, 6-12 Sep. 1971
(ONERA-TP-999) Avail: NTIS

The stability of a laminar flow in a viscous incompressible medium was studied, for the case in which the linearized theory predicts a weak instability. A sufficiently general system of equations verified by the perturbation U was considered for the case of stability exchange. This case is based on the assumption that at neutral stability the only eigenvalue with null real part, for

the linearized problem, is zero. Assuming this eigenvalue to be simple, it was shown that: (1) For the stationary problem, there is bifurcation of the base solution U = 0, and two new stable solutions appear, and (2) For the nonstationary problem, there exists a unique solution bounded for t in the domain of (0,infinity). This solution, for t approaching infinity, leads to one of the stationary bifurcated solutions, provided that the initial perturbation is small enough. The theory applies to the problem of Benard convection, to Couette-Taylor flow between cylinders rotating in the same sense, and to the Burgers turbulence model. Author

**N72-11288*#** Virginia Polytechnic Inst., Blacksburg.
**LAMINAR OR TURBULENT BOUNDARY-LAYER FLOWS OF PERFECT GASES OR REACTING GAS MIXTURES IN CHEMICAL EQUILIBRIUM**
E. C. Anderson and C. H. Lewis Washington NASA Oct. 1971 175 p refs
(Contract NAS1-9337)
(NASA-CR-1893) Avail: NTIS CSCL 20D

Turbulent boundary layer flows of non-reacting gases are predicted for both interal (nozzle) and external flows. Effects of favorable pressure gradients on two eddy viscosity models were studied in rocket and hypervelocity wind tunnel flows. Nozzle flows of equilibrium air with stagnation temperatures up to 10,000 K were computed. Predictions of equilibrium nitrogen flows through hypervelocity nozzles were compared with experimental data. A slender spherically blunted cone was studied at 70,000 ft altitude and 19,000 ft/sec. in the earth's atmosphere. Comparisons with available experimental data showed good agreement. A computer program was developed and fully documented during this investigation for use by interested individuals. Author

**N72-11289*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**CONTRIBUTION TO METHODS FOR CALCULATING THE FLOW ABOUT THIN LIFTING WINGS AT TRANSONIC SPEEDS: ANALYTIC EXPRESSIONS FOR THE FAR FIELD**
E. B. Klunker Washington Nov. 1971 16 p refs
(NASA-TN-D-6530; L-7917) Avail: NTIS CSCL 20D

The problem of determining the small-disturbance flow about two-dimensional airfoils at transonic speeds has been successfully treated by the process of matching a numerical solution of the near field to analytic expressions for the far field. The three-dimensional problem, it would appear, can be treated in a similar way with the aid of algorithms adapted to high-speed and high-capacity computers. The far-field potential for both lifting and nonlifting three-dimensional wings at transonic speeds is developed herein for a subsonic free stream. This potential could be used for a three-dimensional-wing computation similar to the computation made for the two-dimensional wing. Author

**N72-11290#** Gottingen Univ. (West Germany). Drittes Physikalisches Inst.
**BIBLIOGRAPHY ON CAVITATION AND BUBBLE FORMATION IN FLUIDS [KAVITATION UND BLASENBILDUNG IN FLUESSIGKEITEN]**
W. Lauterborn, U. Radek, E. Wolf, and H. W. Strube Apr. 1970 200 p refs Partly in GERMAN and partly in ENGLISH
Avail: NTIS

A bibliography is presented containing references, mostly with abstracts, in the fields of: vibration cavitation, cavitation flow, bubble dynamics, cavitation nuclei, materials damage, shock waves, sonoluminescence, subharmonics in cavitation noise, and cavitation by laser light. The period covered is approximately 1944 to 1970. ESRO

**N72-11291#** National Physical Lab., Teddington (England). Aerodynamics Div.
**EFFECTS OF REYNOLDS NUMBER AND FREQUENCY PARAMETER ON CONTROL-SURFACE BUZZ AT HIGH SUBSONIC SPEEDS**
Y. Nakamura Feb. 1970 22 p refs
(NPL-AERO-1312; ARC-31897) Avail: NTIS

Oscillatory hinge-moment derivatives and limit cycle amplitudes were measured on an airfoil-flap combination model over the Mach number range 0.78 to 0.81 within a buzz region. Stagnation pressure was varied from 100,000 N/sq m to 200,000 N/sq m. The magnitude of both derivatives and the limit cycle amplitude tended to increase with increasing Reynolds number. The effect of increasing frequency was to produce a relatively large decrease in limit cycle amplitude and the magnitude of the derivatives. Author (ESRO)

**N72-11292#** Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).
**IMPULSE TRANSFER OF DIFFUSING GASES AT WALLS [IMPULSUEBERTRAGUNG VON DIFFUSIERENDEN GASEN AN WAENDEN]**
Heinz Lang Jul. 1971 31 p refs In GERMAN
(Rept-3/1971) Avail: NTIS; Max-Planck-Inst. fuer Stroemungsforsch., Goettingen: 9,10 DM

The impulse current density transferred by the components of a binary gas mixture to the wall is calculated for small Knudsen numbers. Overall pressure and temperature are assumed to be constant. The impulse current density is represented as a function of the diffusion slip coefficient. The relations are valid for arbitrary molecular force laws. Maxwellian boundary conditions are assumed for the boundary interaction, which enables extension to more general, linearized, boundary conditions. ESRO

**N72-11293*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**CENTRIFUGAL HYDROPHOBIC SEPARATOR Patent Application**
Franklin W. Booth and Robert A. Bruce, inventors (to NASA) Filed 9 Aug. 1971 14 p
(NASA-Case-LAR-10194-1; US-Patent-Appl-SN-169962) Avail: NTIS CSCL 20D

A centrifugal separator is described which uses a lyophobic filter for removing liquid particles from a mixed stream of gas and liquid under various negative or positive external acceleration conditions, as well as zero g or weightless conditions. Rotating the filter and placing it at an angle to the entering flow improves the lyophobic properties of the filter, provides gross separation of larger liquid particles, and prevents prolonged contact of liquid droplets with the spinning filter which might change the filter properties or block the filter. NASA

**N72-11294#** Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
**THE TRANSONIC REGION OF A SUPERSONIC BOUNDARY LAYER TURNING A SHARP CORNER**
B. D. Fishburn and T. C. Adamson, Jr. Sep. 1971 28 p refs Backup document for AIAA synoptic scheduled for publication in AIAA Journal in Feb. 1972
(Contract DAHC04-69-C-0074)
Avail: NTIS

The transonic region of a supersonic boundary layer which ends at a sharp corner is considered, where the pressure drop across the corner is large enough that separation occurs. Viscous effects in the corner region are important only in a negligibly thin sublayer and where the sonic line intersects the corner. The transonic, inviscid, rotational flow region at and near the corner is analyzed for the case where the incoming boundary layer may have both a pressure gradient and heat transfer at the wall. Solutions are found in the form of asymptotic expansions. It is found that the sonic line is tangent to a straight line which intersects the corner at an acute angle, relative to the upstream wall, with the magnitude of the angle depending on the boundary layer pressure gradient and heat transfer at the corner. The pressure gradient at the wall is shown to be constant. Numerical computations are presented. Author

N72-11295# National Physical Lab., Teddington (England). Aerodynamics Div.
**PITOT-STEM BLOCKAGE CORRECTIONS IN UNIFORM AND NON-UNIFORM FLOW**
R. W. F. Gould London Aeron. Res. Council 1971 30 p refs Supersedes NPL-AERO-1322;ARC-32283
(ARC-CP-1175; NPL-AERO-1322; ARC-32283) Avail: NTIS; HMSO: 42.5p; BIS: $1.80

Wind tunnel measurements are described which determine the error introduced into static pressure measurements in a pipe or duct by the presence of a pitot (or other) stem downstream of the plane of measurement. The effects measured in a uniform stream are used to calculate corresponding stem-blockage corrections in nonuniform flow. The method is applied to fully developed pipe flow measurements in circular and rectangular ducts. Author (ESRO)

N72-11296# Oak Ridge Gaseous Diffusion Plant, Tenn. Nuclear Div.
**INTERNAL RAREFIED GAS FLOWS WITH BACKSCATTERIN. PART 2: FREE MOLECULE FLOW THROUGH FINITE CAPILLARIES**
A. S. Berman (Minn. Univ.) 16 Jun. 1971 15 p refs
(Contract W-7405-eng-26)
(K-1798-Pt-2) Avail: NTIS

Backscattering decreases the transport through such systems (relative to the transport with fully diffuse scattering) by an amount which depends upon the probability of backscattering and the length-to-radius ratio of the capillary. Comparison with observed flows in short capillaries leads to an estimate of 0.04 for the probability of backscattering from unprepared randomly rough surfaces. Author

N72-11297# Rensselaer Polytechnic Inst., Troy, N.Y.
**STATISTICAL STUDY OF THE PRESSURE FLUCTUATIONS IN A FLUIDIZED BED**
Rufino C. Lirag, Jr. and Howard Littman [1971] 45 p refs
(RPI-3639-15) Avail: NTIS

Pressure fluctuations in a fluidized bed and in the plenum below the bed were subjected to a statistical analysis to identify a periodic component in the fluctuations. The fluctuations observed are caused by fluctuations in the bed height resulting from bubbles escaping at the surface of the bed. The effect of gas velocity, bed height, particle size, and density on the frequency and amplitude of the periodic component were investigated, along with the frequency used to calculate the average bubble size leaving the bed. Author

N72-11298# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
**INTERNAL RAREFIED GAS FLOWS WITH BACKSCATTERING. PART 4: PLANE POISEUILLE FLOW WITH BACKSCATTERING**
A. S. Berman 16 Jun. 1971 25 p refs
(Contract W-7405-eng-26)
(K-1798-Pt-4) Avail: NTIS

Plane Poiseuille flow at arbitrary Knudsen number is computed using the BGK model equation and a boundary condition which permits a fraction (1 - alpha) of molecules incident on the walls to be scattered back along their incident path while a fraction alpha are diffusely scattered. The inclusion of backscattering reduces the transport in the free molecule and near free molecule regions while the transport in the continuum region is relatively unaffected. With a value of alpha = 0.94, comparison of predicted transport with the transport of hydrogen between glass plates is made. It is found that the inclusion of backscattering significantly improves the agreement between observed and predicted flow. Author (NSA)

N72-11299# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
**INTERNAL RAREFIED GAS FLOWS WITH BACKSCATTERING. PART 5: FLOW IN CAPILLARIES AND ANNULI**
A. S. Berman 16 Jun. 1971 22 p refs
(Contract W-7405-eng-26)
(K-1798-Pt-5) Avail: NTIS

The flow through a long tube of arbitrary but constant cross section is computed using the BGK model equation and a boundary condition which permits a fraction 1 - alpha of the molecules incident on the tube walls to be scattered back along their incident path while a fraction alpha are diffusely scattered. For the special cases of circular and annular cross sections, a comparison is made of predicted and observed flows. In the comparison a value of alpha = 0.94 is used. Significantly better agreement between observed and predicted transport results from the inclusion of backscattering. Author (NSA)

N72-11300# Sussex Univ., Brighton (England). Lab. for Mechanical Engineering.
**BOUNDARY-LAYER PREDICTION METHODS APPLIED TO COOLING PROBLEMS IN THE GAS TURBINE**
F. J. Bayley, W. D. Morris, J. M. Owen, and A. B. Turner London Aeron. Res. Council 1971 43 p refs Sponsored in part by Min. of Technol. and Rolls-Royce
(ARC-CP-1164; ARC-32050) Avail: NTIS HMSO: 60p; PHI: $2.65

Integral and differential theories have been used, and applied to flows over convection- and transpiration-cooled turbine blades and simplified representations of combustion systems and turbine disks. Author (ESRO)

N72-11301# Defense Documentation Center, Alexandria, Va.
**TWO DIMENSIONAL FLOW, VOLUME 1 Report Bibliography, Nov. 1960 - Nov. 1970**
Jun. 1971 305 p refs
(AD-724800; DDC-TAS-71-25-1-Vol-1) Avail: NTIS HC $8.00/MF $0.95 CSCL 20/4

The annotated bibliography, Volume I of II volumes, provides selected references in the subject area of two-dimensional flow. These citations are based on actual and experimental conditions as applied to two-dimensional flows. Corporate author-monitoring agency, subject, title, personal author, contract, and report number indexes are included. Author (GRA)

N72-11302# Wisconsin Univ., Madison. Water Resources Center.
**APPLICATION OF MAGNETOHYDRODYNAMICS TO MEASUREMENT OF LIQUID VELOCITY AND TURBULENCE**
J. R. Villemonte, John A. Hoopes, and H. Lettau Heinz Jul. 1971 82 p refs
(Contracts DI-14-01-0000-1058; DI-14-31-0001-3050; OWRR Proj. B-012-WIS(2); OWRR Proj. A-033-WIS(2))
(PB-201695; PL-88-379) Avail: NTIS CSCL 20D

A study of the application of MHD techniques to the measurement of turbulence in the flow of water in pipes, the structure of turbulence of a 2-D jet of water impinging into a stagnant body of water, and the use of the portable MHD drogue-like mean and turbulent velometers is presented. A three element probe was developed permitting the simultaneous measurement of the axial and radial components of the turbulent velocities. Also measured were energy spectra, turbulent intensities and various other correlations. Conclusions indicate that the turbulent velocity of water are similar to those for air, but water intensities are 1/3 those of air. Conclusions also indicate the MHD velometer is better suited for such measurements than traditional velometers. Author (GRA)

N72-11303# Missouri Univ., Rolla. Dept. of Chemical Engineering.
**TURBULENCE MEASUREMENTS IN LIQUIDS**
G. K. Patterson and J. L. Zakin 27 May 1971 150 p refs Presented at the Symp. on Turbulence Measurements in Liquids, Rolla, Mo., Sep. 1969
(Contract DA-ARO(D)-31-124-G1114)

(AD-724773; AROD-8351-1-E) Avail: NTIS CSCL 20/4

The symposium was designed to bring together people of all disciplines interested in liquid turbulence measurements. A recent important development is the laser doppler velocimeter which has the major advantage of not requiring a probe and hence of not dinturbing the flow at low velocities. Measurements in Newtonian liquids were reported. The third session, in modified fluids, dealt with stratified liquids, dilute polymer solutions, and gas-liquid systems. The fourth session also dealt with Newtonian liquids, including stability measurements in rozating pipes. GRA

N72-11304# Wisconsin Univ., Madison. Mathematics Research Center.

**ON THE DESCRIPTION OF RHEOLOGICAL PROPERTIES OF VISCOELASTIC CONTINUA. 2: PROOF THAT OLDROYDS 1950 FORMALISM INCLUDES ALL SIMPLE FLUIDS**

A. S. Lodge and J. H. Stark Aug. 1970 32 p refs

(Contract DA-31-124-ARO(D)-462)

(AD-725083; MRC-TSR-1093) Avail: NTIS CSCL 20/11

It is proved that all incompressible 'Simple Fluids' are included in the convected-component formalism for constitutive equations. Author (GRA)

N72-11305# Wisconsin Univ., Madison. Mathematics Research Center.

**A NOTE ON ROTATIONALLY SYMMETRIC FLOW ABOVE AN INFINITE ROTATING DISC**

J. B. McLeod Oct. 1970 20 p refs

(Contract DA-31-124-ARO(D)-462)

(AD-725081; MRC-TSR-1078) Avail: NTIS CSCL 20/4

The boundary value problem was studied which arises from the behavior of a fluid occupying the half-space x greater than zero above a rotating disk. The disk is coincident with the plane x = 0 and rotates about a fixed axis. Results of the equation include bounds on possible solutions to the boundary value problem, a proof of uniqueness of the solution in the particular case Omega sub zero = Omega sun infinity and a less than or equal to 0, and a proof of nonexistence in the particular case Omega sub zero = - Omega sub infinity and a less than or equal to 0. Author (GRA)

N72-11306# Picatinny Arsenal, Dover, N.J. Engineering Sciences Lab.

**NON-GREY ABSORPTION MODELS OF ABLATOR VAPORS AT HIGH TEMPERATURES WITH APPLICATION TO HYPERSONIC FLOW FIELDS**

Henry E. Hudgins, Jr. Apr. 1971 103 p refs

(AD-724750; PA-TR-4116; AMC-8-70(IN)) Avail: NTIS CSCL 07/4

A representation of the exact spectral absorption coefficients due to the atomic continua and molecular bands of typical ablators containing C, H, O, and Si was constructed. This representation then was fitted by a multi-band model using 12 bands between h sub nu = 0.1 and 24.4 eV. The band model permits much more rapid calculation in applications than an exact model, while retaining the non-grey characteristics of the actual absorption coefficient with good accuracy as shown by various comparisons. The effect of the large uncertainties in the molecular f-numbers is investigated and found to be significant for hv - 10 eV at temperatures below about 15000 to 10000 K at pressures from 10 to 0.1 atmospheres. Spectral absorption coefficients and Planck and Rosseland mean absorption coefficients for carbon phenolic are also presented for a range of pressures from 0.1 to 10.0 atmospheres at temperatures from sublimation to 18000K. Instructions for the utilization and application of the model are provided. Author (GRA)

N72-11307# Aerospace Corp., El Segundo, Calif. Lab. Operations.

**PRESSURE INTERACTION METHODS FOR AXISYMMETRIC, HYPERSONIC, LAMINAR, UNSEPARATED FLOWS Technical Report, Jan. 1969 - Nov. 1970**

John W. Ellinwood 30 Mar. 1971 53 p refs

(Contract F04701-70-C-0059)

(AD-725735; TR-0059(6240-10)-3; SAMSO-TR-71-115) Avail: NTIS CSCL 18/3

Local-similarity methods suitable for flows with axisymmetric hypersonic viscous interaction are provided for three limit flows. The first method is for flow with a strong shock wave over sharp or hollow cylinders; this compares with an existing solution for cones and 3/4 power-law bodies. The second is a new local solution for general, very thin bodies; it becomes exact when the pressure ratio approaches 1 or is unbounded. The third, for power-law bodies with linearized inviscid flow, becomes exact when the ratio of boundary-layer to body thickness vanishes or is unbounded. Together with classical results for very thin boundary layers, these diverse methods provide interpolated estimates of pressure and heat transfer rate on a very slender cone-cylinder in hypersonic flow that compare well with original experimental data. Author (GRA)

N72-11308# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.

**RESEARCH ON ADVANCED AXIAL COMPRESSOR CONCEPTS Final Scientific Report, 1 Nov. 1970 - 31 Jan. 1971**

F. A. E. Breugelmans, J. Chauvin, H. Rottiers, J. Salvage, and B. Roberts 25 Feb. 1971 65 p refs

(Contract F61052-69-C-0025; AF Proj. 7065)

(AD-725789; ARL-71-0093) Avail: NTIS CSCL 13/7

The report covers work carried out on advanced axial compressor concepts. Cascade calculations and testing on blunt trailing edge (BTE) blades and conventional blades are described covering optimization of external and internal diffusion in BTE blade passages, low Reynolds number performance and detailed secondary flow investigations. The effort on the BTE diffusion optimization was concentrated on the experimental study of the flow from the trailing edge to infinity. Relative trailing edge thickness and trailing edge form have an influence on the Strouhal number. The latter is most prevalent. Author (GRA)

N72-11309# Brown Univ., Providence, R.I. Div. of Applied Mathematics.

**[MATHEMATICAL ANALYSIS OF FLUID DYNAMICS RESEARCH] Final Report, 1 Sep. 1965 - 1 Aug. 1970**

1 Aug. 1970 13 p refs

(Contracts N00014-67-A-0191-0017; Nonr-562(42); NR Proj. 062-170)

(AD-724739) Avail: NTIS CSCL 20/4

The report contains brief descriptions of the technical reports that have been written with the support of contract Nonr-562(42), during the period 1 September 1965 to 1 August 1970. Author (GRA)

N72-11310# Air Force Systems Command, Wright-Patterson AFB, Ohio.

**A REARWARD FACING STEP IN A HYPERSONIC STREAM**

Joseph J. S. Shang, Wilbur L. Hankey, and Douglas L. Dwoyer Feb. 1971 42 p refs

(AF Proj. 7064-00-07)

(AD-725066; ARL-71-0030; DOD-Element-61102F; DOD-Subelement-681307) Avail: NTIS CSCL 20/4

An experimental investigation was conducted for hypersonic flow over a rearward-facing step. The inviscid dominated region around this configuration was investigated by the method of rotational characteristics. The recirculation region was described by a primary expansion angle for the dividing streamline. The calculated results were compared with the experimental measurements as the critical verification. This comparison exhibited a favorable substantiation for the present analysis. Static pressure distributions on the model surface and impact pressure surveys were presented along with visual observations. A study of the three-dimensional effects on the finite span 'two-dimensional' model is also presented. Author (GRA)

N72-11311# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineering.
**THE INVESTIGATION FOR THE AERODYNAMIC AND HEAT TRANSFER CHARACTERISTICS OF SLENDER HYPERSONIC CONES OVER A WIDE RANGE OF ANGLES OF ATTACK Technical Report, 1 Jan. 1969 - 30 May 1971**
Paul K. Chang, Sin K. Oh, Russel A. Smith, B. H. Yim, R. U. Jettmar, and Youn H. Oh 30 May 1971 134 p refs
(Contract DAHC60-70-C-0055)
(AD-725606; TR-4) Avail: NTIS CSCL 16/3

The problems of aerodynamic and heat transfer characteristics of slender shap-nosed hypersonic cones over a wide range of angles of attack are examined and the analytical solutions are presented. Three particular problems are studied: (1) inviscid flow characteristics of the shock layer, involving laminar separation on the leeward side with undistributed free stream Mach number 7.95 and angle of attack 20 degrees for cone half angle 10 degrees, (2) attached three-dimensional compressible boundary layer over the cone, and (3) aerodynamic and heat transfer characteristics of turbulent separated flow. Author (GRA)

N72-11312# Air Force Systems Command, Wright-Patterson AFB, Ohio.
**EXPERIMENTAL STUDY OF SHOCK IMPINGEMENT ON A BLUNT LEADING EDGE WITH APPLICATION TO HYPERSONIC INLET DESIGN Technical Report, Dec. 1967 - Mar. 1969**
Roger R. Craig and Paul J. Ortwerth Apr. 1971 44 p refs
(AF Proj. 3012)
(AD-726111; AFAPL-TR-71-10) Avail: NTIS CSCL 20/4

An experimental study was made of the interaction of an oblique shock with the bow shock of blunt leading edge. The interactions were classified according to the interference patterns described by Edney. Peak heating rates 5.5 times those of the blunt leading edge alone were studied. All interactions appeared to be unsteady except when the slipstream of the interaction passed above the blunt leading edge. Author (GRA)

N72-11743*# Translation Consultants, Ltd., Arlington, Va.
**A THEORY OF NONSTATIONARY NONADIABATIC SHOCK WAVES**
I. A. Klimishin *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 13-27 refs (See N72-11740 02-30)
Avail: NTIS CSCL 20D

# 13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N72-11313 National Lending Library for Science and Technology, Boston Spa (England).
**DISPERSION ANALYSIS OF THE RESULTS OF HARMONIC ANALYSIS OF REGISTRATION OF THE EARTH'S TIDES [DISPERSIONEN ANALIZ NA REZULTATI OT KHARMONICHEN ANALIZ NA ZEMNOPRILIVNI REGISTRATSII]**
Kh. Georgiev and A. Venedikov Jul. 1971 4 p refs Transl. into ENGLISH from Izv. Geofiz. Inst., Bulg. Akad. Nauk. (Bulgaria), v. 16, 1970 p 153-155
(NLL-RTS-6558) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.40; 1 NLL photocopy coupon

An error in previous variant of dispersion analysis for processing results of harmonic analysis of earth tide data is avoided by using a different approach. The observations subjected to dispersion analysis are tabulated for each station, as are the resulting values of the vertical aand horizontal components. It is felt that a comparison of these values with critical values results in an ambiguous interpretation. N.E.N.

N72-11314 National Lending Library for Science and Technology, Boston Spa (England).
**THE STRUCTURE OF THE EARTH'S CRUST AT DEPTH IN THE BELOZERKA IRON BEARING REGION FROM THE DATA OF SEISMIC SURVEYS [GLUBINNOE STROENIE ZEMNOI KOPY BELOZERSKOGO ZHELEZORUDNOGO RAIONA PO DANNYM SEISMICHESKIKH ISSLEDOVANNI]**
V. B. Sollogub, A. V. Chekunov, L. T. Kalyuzhnaya, L. A. Khilinskii, I. A. Garkalenko, and P. G. Trifonov Sep. 1971 35 p refs Transl. into ENGLISH from Geofiz. Sb., Akad. Nauk Ukr. SSR (Ukrainia SSR), v. 18, 1966 p 3-18
(NLL-RTS-5548) Avail: Natl. Lending Library, Boston Spa, Engl.: £3.50; 12 NLL photocopy coupons

The results of a low frequency seismic survey of the Belozerka region using the correlating method for refracted waves, which was undertaken in 1960 to 1963, are presented. The system and method of observation are described and seismic sections are constructed. It was found that the lower and upper part of the consolidated crust is layered according to elastic properties, and the layers are mainly horizontal. The synchrony of the Belozerka structure formed by sedimentary and volcanic iron-bearing formations, with graben, and the coinciding of the graben shape with the Belozerka magnetic anomaly shape are discussed. It is concluded that low frequency seismic surveys show great possibilities for studying internal structure with dislocated and metamorphosed geological complexes. N.E.N.

N72-11315 National Lending Library for Science and Technology, Boston Spa (England).
**RELATIVE WATER TRANSPARENCY OF THE INDIAN OCEAN**
V. I. Voitov and M. G. Dementyeva 19 Aug. 1971 6 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 10, no. 1, 1970 p 48-50
(NLL-NSTIC-Trans-2344-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

From observations of the depth of visibility of the white disc made chiefly in recent years, a map of the relative water transparency has been made for the northern part of the Indian Ocean and Antarctic waters. The relationship between the relative transparency and the plankton concentration is analyzed along with the connection between the relative transparency distribution and the circulation of surface waters. Author

N72-11316 National Lending Library for Science and Technology, Boston Spa (England).
**CONSTRUCTION OF LINEAR NUMERICAL FILTERS FOR DETERMINATION OF INSTRUMENTAL MOVEMENT AND DISPLACEMENT IN THE REGISTRATION OF THE EARTH'S TIDES [POSTROYAVANE NA LINEINI CHISLOVI FILTRIZA OPREDELYANE INSTRUMENTALNIYA KHOD I OTMESTVANETO NA ZEMNOPRILIVNI REGISTRATSII]**
A. Venedikov Aug. 1971 16 p refs Transl. into ENGLISH from Izv. Geol. Inst. Bulgar. Akad. Nauk (Sofia), no. 16, 1970 p 137-151
(NLL-RTS-6557) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.60 or 5 NLL photocopy coupons

An explanation is given of the practical application of the method used to construct linear numerical filters for registration processing of earth tides. Basic points about filter construction are demonstrated by instrumental movement and displacement during registration. Also given are the necessary designations and detailed description of the different stages of filter construction. Results are given in tables. E.H.W.

N72-11317 National Lending Library for Science and Technology, Boston Spa (England).
**HYDROMETEOROLOGICAL CONDITIONS IN THE ICING-**

**UP OF VESSELS AT SEA**
A. N. Shekhtman 1 Jun. 1971 21 p refs Transl. into ENGLISH from Moscow Nauk Issled Inst. Aeroklim. T. Vyp (Moscow), v. 45, 1964 p 51-63
(NLL-NSTIC-Trans-3211-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The circumstances of icing-up are defined, and recommendations for the further study of hydrometeorological factors which influence the icing-up of vessels are given. The effects of icing on decks, machinery, rigging, and external communications are evaluated. Author

**N72-11318** Institute of Geological Sciences, London (England).
**MAGNETIC RESULTS 1968: ESKDALEMUIR, HARTLAND AND LERWICH OBSERVATORIES**
1970 167 p *Its* Geomagnetic Bull. no. 2
Copyright. Avail: HMSO £2.50; PHI $9.69

The hourly values and daily means of the declination, horizontal intensity, and vertical intensity; the K(D), K(H), and K indices; and the diurnal inequalities are tabluated for 1968. N.E.N.

**N72-11319*#** Earth Satellite Corp., Washington, D.C.
**US FISHING INDUSTRY PARTICIPATION IN NASA'S EARTH RESOURCES SURVEY PROGRAM: COMMUNICATIONS BETWEEN NASA AND THE US FISHING INDUSTRY**
Final Report
P. M. Maughan, A. D. Marmelstein, K. Hecht, G. C. Broadhead (Living Marine Resources, Inc.), F. G. Alverson (Living Marine Resources, Inc.), C. G. Peckham et al Mar. 1971 160 p refs Prepared in cooperation with Living Marine Resources, Inc., San Diego, Calif.
(Contract NASw-2133)
(NASA-CR-123202) Avail: NTIS CSCL 08A

A study to evaluate the applications of remote sensing in commercial fishing is reported, and the basis for effective communications between NASA and the U.S. fishing industry are established. Detailed information is presented in the following areas: organization of the fishing complex and communication levels within and between the components; organization of the fishing industry and the communications within and between both selected fisheries and various industry groups; relationships and communications between federal, state, and local government agencies and the fishing industry; relationships and communications between international and regional fisheries commissions; and intergovernmental agency relationships relevant to the fishing industry. It will be necessary to educate those individuals having access to the techniques and resultant data, and channels for distribution of the information to selected fisheries are recommended. Procedures for feedback information loops are also established. N.E.N.

**N72-11320#** National Physical Lab., New Delhi (India). Radio Science Div.
**IONOSPHERIC DATA, MARCH 1970**
Mar. 1970 79 p
(RTRC-A178) Avail: NTIS

Tables of hourly values of propagation data for the E and F regions are presented for several stations in India. These include critical frequency, minimum virtual height, F-min, and M(3000)F2 data. Author

**N72-11321#** National Physical Lab., New Delhi (India). Radio Science Div.
**IONOSPHERIC DATA, FEBRUARY 1970**
Feb. 1970 79 p
(RTRC-A177) Avail: NTIS

Tables of hourly values of propagation data for the E and F regions are presented for several stations in India. These include critical frequency, minimum virtual height, F-min, and M(3000)F2 data. Author

**N72-11322#** National Physical Lab., New Delhi (India). Radio Science Div.
**IONOSPHERIC DATA, JANUARY 1970**
Jan. 1970 79 p refs
(RTRC-A176) Avail: NTIS

Tables of hourly values of propagation data for the E and F regions are presented for several stations in India. These include critical frequency, minimum virtual height, F-min, and M(3000)F2 data. Author

**N72-11323*#** Texas A&M Univ., College Station. Environmental Engineering Div.
**A PRACTICAL METHOD OF DETERMINING WATER CURRENT VELOCITIES AND DIFFUSION COEFFICIENTS IN COASTAL WATERS BY REMOTE SENSING TECHNIQUES**
Wesley P. James Oct. 1971 28 p refs
(Grants NGL-44-001-001; IAC-(72-73)-156)
(NASA-CR-123314; RSC-34) Avail: NTIS CSCL 08C

A simplified procedure is presented for determining water current velocities and diffusion coefficients. Dye drops which form dye patches in the receiving water are made from an aircraft. The changes in position and size of the patches are recorded from two flights over the area. The simplified data processing procedure requires only that the ground coordinates about the dye patches be determined at the time of each flight. With an automatic recording coordinatograph for measuring coordinates and a computer for processing the data, this technique provides a practical method of determining circulation patterns and mixing characteristics of large aquatic systems. This information is useful in assessing the environmental impact of waste water discharges and for industrial plant siting. Author

**N72-11324*#** Texas A&M Univ., College Station. Environmental Engineering Div.
**QUANTITATIVE EVALUATION OF WATER QUALITY IN THE COASTAL ZONE BY REMOTE SENSING**
Wesley P. James Sep. 1971 70 p refs
(Grants NGL-44-001-001; IAC-(72-73)-156)
(NASA-CR-123313; RSC-33) Avail: NTIS CSCL 08A

Remote sensing as a tool in a waste management program is discussed. By monitoring both the pollution sources and the environmental quality, the interaction between the components of the exturaine system was observed. The need for in situ sampling is reduced with the development of improved calibrated, multichannel sensors. Remote sensing is used for: (1) pollution source determination, (2) mapping the influence zone of the waste source on water quality parameters, and (3) estimating the magnitude of the water quality parameters. Diffusion coefficients and circulation patterns can also be determined by remote sensing, along with subtle changes in vegetative patterns and density. J.A.M.

**N72-11325*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MAGNETIC FIELD FLUCTUATIONS DURING SUBSTORMS**
D. H. Fairfield Sep. 1971 45 p refs Presented at the Moscow Symp. on Magnetospheric Substorms, Aug. 1971 Submitted for publication
(NASA-TM-X-65748; X-692-71-453) Avail: NTIS CSCL 03B

Before a magnetospheric substorm and during its early phases the magnetic field magnitude in the geomagnetic tail increases and field lines in the nighttime hemisphere assume a more tail-like configuration. Before the substorm onset a minimum amount of magnetic flux is observed to cross the neutral sheet which means that the neutral sheet currents attain their most earthward locations and their greatest current densities. This configuration apparently results from an increased transport of magnetic flux to the tail caused by a southward interplanetary magnetic field. The field begins relaxing toward a more dipolar configuration at the time of a substorm onset with the recovery probably occurring first between 6 and 10 R sub E. This recovery must be associated with magnetospheric convection

which restores magnetic flux to the dayside hemisphere. Field aligned currents appear to be required to connect magnetospheric currents to the auroral electrojets, implying that a net current flows in a limited range of longitudes. Space measurements supporting current systems are limited. More evidence exists for the occurrence of double current sheets which do not involve net current at a given longitude. Author

N72-11326*# Illinois Univ., Urbana. Aeronomy Report No. 42
**PARTIAL REFLECTION DATA COLLECTION AND PROCESSING USING A SMALL COMPUTER**
M. H. Birley and C. F. Sechrist, Jr. 1 Jun. 1971 113 p refs
(Grant NGR-14-005-013)
(UILU-ENG-71-2501; NASA-CR-123316; Rept-42) Avail: NTIS CSCL 03B

Online data collection of the amplitudes of circularly polarized radio waves, partially reflected from the D region of the earth's ionosphere, has enabled the calculation of an electron-density profile in the height region 60-90 km. A PDP 15/30 digital computer with an analog to digital converter and magnetic tape as an intermediary storage device are used. The computer configuration, the software developed, and the preliminary results are described. Author

N72-11327*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A THERMOSPHERE COMPOSITION MEASUREMENT USING A QUADRUPOLE MASS SPECTROMETER WITH A SIDE ENERGY FOCUSSING QUASI-OPEN ION SOURCE**
Hasso B. Niemann, Nelson W. Spencer, and Gerald A. Schmitt Jul. 1971 66 p refs
(NASA-TM-X-65731; X-621-71-300) Avail: NTIS CSCL 03B

The atomic oxygen concentration in the altitude range 130 to 240 km was determined through the use of a quadrupole spectrometer with a strongly focussing ion source. The instrument is used in the Thermosphere Probe in a manner that greatly increases the proportion of measured oxygen ions that have not experienced a surface collision and permits quantitative evaluation of surface recombination and thermalization effects which inevitably enter all spectrometer determinations. The data obtained strengthen the concept that consideration of surface effects is significant in quantifying spectrometer measurements of reactive gases, and tend to be in agreement with von Zahn's recent results. Author

N72-11328*# Pittsburgh Univ., Pa. Space Research Coordination Center.
**TWILIGHT AND NIGHTTIME IONOSPHERIC TEMPERATURES FROM OXYGEN WAVELENGTHS 6300 AND 5577 SPECTRAL LINE PROFILES** Journal of Geophysical Research
W. A. Feibelman, R. D. Hake, Jr., D. P. Sipler, and M. A. Biondi Sep. 1971 25 p refs Sponsored in part by the A. W. Mellon Educational and Charitable Trust, the Maurice Falk Med. Fund, the Richard King Mellon Found., and the Sarah Mellon Scaife Found.
(Grant ngr-39-011-002)
(NASA-CR-123317; SRCC-159; APP-28) Avail: NTIS CSCL 03B

Fabry-Perot interferometer measurements of atomic oxygen 6300 A and 5577 A line profiles from twilight and nightglow are used to determine the neutral temperatures in F2 and E regions of the earth's ionosphere. The exospheric temperatures T sub n (infinity) determined from the 6300 A profiles are usually somewhat higher than those calculated from Jacchia's model, with differences as large as approximately 300 K noted when T sub n (infinity) = 1500 to 1600 K. The post-sunset and pre-dawn rate of change of T sub n (infinity) is often substantially larger than the Jacchia prediction. The 5577 A (E-region) measured temperatures range from 200 to 220 K on quiet nights to 500 to 600 K during geomagnetic storms. Author

N72-11329# Woods Hole Oceanographic Institution, Mass.
**WINTERTIME INTERACTIONS OF THE ATMOSPHERE WITH THE MEDITERRANEAN SEA**
Andrew F. Bunker and Margaret Chaffee Cornell Oct. 1971 77 p refs
(Contract Nonr-241(13); Grant NSF GA-27218)
(Ref-71-61) Avail: NTIS

The flux of heat and water vapor was measured by several techniques during February 1969 while the surface water south of France was sinking to the bottom. These measurements show that the sea loses more than 300 cal/sq cm/day and more than 0.5 gm/sq cm/day of water during the winter. On days when the Mistral wind is blowing, the average heat loss rises to 1200 cal/sq cm/day and the water loss to 1.5 gm/sq cm/day. Author

N72-11330# International Antarctic Meteorological Research Centre, Melbourne (Australia).
**THE GENERATION OF AVAILABLE POTENTIAL ENERGY BY SENSIBLE HEATING IN SOUTHERN OCEAN CYCLONES**
B. R. Bullock and D. R. Johnson Sep. 1971 55 p refs
(TR-13) Avail: NTIS

The generation of available potential energy due to the turbulent transfer of sensible heat from the ocean to the atmosphere has been estimated for late developing and occluding stages of one cyclone and the occluding stage of a second, both storms being located in the Australian sector of the Southern Ocean. The exact generation expression of Johnson was applied to a volume centered about the storm, and a model for estimating the turbulent transfer of heat into the layer of convective mixing was developed. The generation of frictional dissipation ratio of 1:4 and 1:10 for the two stages indicated that the in situ diabetic source of storm available potential energy was significant in the cyclogenetic stage but that its importance decreased as the storm decayed. Author

N72-11331# Kiruna Geophysical Observatory (Sweden).
**COMPARISON OF SIMULTANEOUS SATELLITE MEASUREMENTS OF AURORAL PARTICLE PRECIPITATION WITH BOTTOMSIDE IONOSONDE MEASUREMENTS OF THE ELECTRON DENSITY IN THE F-REGION**
Tauno Turunen and Ludwik Liszka Aug. 1971 12 p refs Sponsored by Swed. Natl. Council of Nat. Sci. and supported in part by the Students Found. of Oulu
Avail: NTIS

Satellite measurements of auroral particle precipitation made on board the polar orbiting satellite ESRO -1A for satellite orbits are compared with simultaneous bottomside ionosonde measurements from Scandinavian network. It is found that in the investigated cases the boundaries of the precipitation zone and the polar plasma torus and the trough are very well tied together. Author

N72-11332# Weapons Research Establishment, Adelaide (Australia).
**RESULTS OF AN OPTICAL OZONESONDE TEST FLIGHT CONDUCTED FROM MILDURA, AUSTRALIA, 21 DECEMBER 1966**
N. V. Sissons Mar. 1970 26 p refs
(WRE-TN-HSA-168) Avail: NTIS

An optical system for the determination of atmospheric ozone densities has been designed for use with dropsonde. As a first attempt to obtain a workable system, a photometer was designed to respond to solar ultraviolet radiation around 2900 angstroms at altitudes above the region of mid-latitude ozone maximum density, located at approximately 22 km. The photometer was attached to the gondola of one of the HIBAL high altitude sampling flights to 37 km. The results expected from the test flight were: (1) measurements of the photometer response to the radiation gradient in the altitude range 22 km to the balloon peak altitude, and (2) the determination of an ozone profile within this altitude range. The experimental instrumentation is described and the results from the test flight are shown. The

ozone profile so calculated was compared with those obtained from two electrochemical ozonesondes flown on the same day from two other locations. Author

N72-11333# Washington Univ., Seattle. Dept. of Oceanography.
**NUMERICAL MODEL FOR DETERMINING THE MIDDLE SCALE TIME DEPENDENT VARIATIONS IN SALINITY AND TEMPERATURE STRUCTURE IN A COASTAL ZONE PROVINCE UNDER THE INFLUENCE OF DILUTION AND UPWELLING**
Alyn C. Duxbury [1970] 73 p refs Sponsored by AEC
(RLO-1725-191; M71-21) Avail: NTIS

A model steady-state equations of motion with viscous terms and the kinematic equations for salt and heat is presented for an area bounded by 42 N and 48 N and extending seaward 390 Km. The flow field is found from streamline values at the east and west boundaries and the local surface wind stress. The velocizy field, x, y, z components, averaged over a time increment is used to determine implicit time changes in heat and salt at four depth layers. Viscous and mixing coefficients are variable over the region and are governed by surface wind speed, stability, and proximity to the coast. Changes in the pressure field determined from predicted salt and heat changes are used to make a second approximation of the flow field which in turn is used to determine a second approximation of the salt and heat changes. Salinity is considered conservative in the model, whereas heat is not conservative as radiation and evaporation are considered. The model predicts upwelling and implicit changes in salt and heat distributions that are commensurate with those observed in the same region. Author

N72-11334# California Univ., Berkeley. Lawrence Radiation Lab.
**CATALYTIC REDUCTION OF STRATOSPHERIC OZONE BY NITROGEN OXIDES**
Harold Johnston Jun. 1971 117 p refs
(Contract W-7405-eng-48)
(UCRL-20568) Avail: NTIS

Quantitative calculations of the destruction of stratospheric ozone by nitrogen ozides omitted from SST's are presented. The calculations cover the following: (1) the rate of destruction of ozone by NO(x) relative to the ozone destruction rate by the couple, 02, 03, and by free radicals derived from water; and, (2) steady state calculations of the profile of ozone in the stratosphere for a wide range of uniform and nonuniform distributions of NO(x). Although special attention is given to NO(x) at 3, 7, 30, and 70 ppb, most calculations cover the complete range from zero to 100 ppb. Over the entire range of stratospheric variables, the oxides of nitrogen, NO and NO2, have a powerful effect in reducing ozone, and a quantity (30 ppb) previously accepted as negligible would reduce the ozone column by about a factor of two, according to two different methods of computation. Author

N72-11335# Oak Ridge National Lab., Tenn. Mathematics Div.
**CODE FOR LINEAR MODELING OF AN ECOSYSTEM**
Mark Reeves, III Jul. 1971 22 p refs Sponsored in part by NSF
(Contract W-7405-eng-26)
(ORNL-IBP-71-2) Avail: NTIS

A computer code is presented for the purpose of solving linear ecosystem models. The general solution of such models is developed in terms of the eigenvalues and eigenvectors of the matrix of internal-flow coefficients and integrals of time-dependent external forcing functions. Numerical methods used to obtain these quantities are mentioned. A thorough discussion of the input and output is given, including variable lists, formats, and control cards, together with an example. Plots and equations are given for all currently available forcing functions. Author

N72-11336# National Oceanic and Atmospheric Administration, Rockville, Md.
**ALEUTIAN SEISMIC PROGRAM SEISMOLOGICAL BULLETIN, MARCH 1970**
Mar. 1971 105 p
(Contract AT(29-2)-746)
(CGS-746-105) Avail: NTIS

Data acquired from the Aleutian network of seismic stations was collected for distribution to facilitate current studies of earthquake occurrence in the Aleutian Islands. Record arrival times and amplitudes are scaled by the special projects party, Las Vegas, Nevada. This compilation is preliminary and may be subject to later revision on the basis of current research. Author

N72-11337# National Oceanic and Atmospheric Administration, Rockville, Md.
**ALEUTIAN SEISMIC PROGRAM SEISMOLOGICAL BULLETIN, DECEMBER 1970**
Jun. 1971 72 p
(Contract AT(29-2)746)
(CGS-746-114) Avail: NTIS

Preliminary data acquired from an Aleutian network of seismic stations is collected for distribution to facilitate current studies of earthquake occurrence in the Aleutian Islands. Record arrival times and amplitudes are scaled. Final reduction and collation of data to event hypocenters and derivation of related parameters are also printed. This compilation is preliminary and may be subject to later revision on the basis of current research. Author

N72-11338# Geological Survey, Washington, D.C. Topographic Div.
**RESEARCH AND DEVELOPMENT Annual Report, Apr. 1970 - Apr. 1971**
Morris M. Thompson Apr. 1971 83 p refs
(PB-200279; USGS-TD-71-001) Avail: NTIS CSCL 08B

The R and D projects concern the fields of cartography, field surveys, photogrammetry, orthophotomapping, and space technology. Articles prepared for presentation at meetings and conferences or for publication in professional journals, the computer contributions series, and the manual of topographic instructions are also listed. Author (GRA)

N72-11339# Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Control Office.
**PHOTOCHEMICAL OXIDANTS AND AIR POLLUTION, AN ANNOTATED BIBLIOGRAPHY. PART 1: CATEGORIES A THROUGH F. PART 2: CATEGORIES G THROUGH N AND INDEXES**
Mar. 1971 1531 p refs
(PB-201210; AP-88; EP4.9:88) Avail: NTIS GPO HC $6.25/set of 2 vol. as EP4.9:88; CSCL 07E

A compilation of approximately 1900 abstracts on photochemical oxidants are presented. Abstracts are arranged in the following categories: General; Emission Sources; Atmospheric Interaction; Measurement Methods; Control Methods; and Effects - Human Health. Indexes and the following categories of abstracts are also presented: Effects - Plants and Livestock; Effects - Materials; Effects - Economic; Air Quality Measurements; Legal and Administrative; Standards and Criteria; Basic Science and Technology; and Social Aspects. GRA

N72-11340# Hawaii Inst. of Geophysics, Honolulu.
**CHANGE IN BATHYMETRIC CONFIGURATION, KANEOHE BAY, OAHU, 1882-1969**
Kenneth J. Roy Oct. 1970 71 p refs
(Grant NSF GH-28-1)
(PB-201103; HIG-70-15; Seagrant-70-6) Avail: NTIS CSCL 08J

Kaneohe Bay is in part an estuary, and as such, its expected lifetime is relatively short. Important questions are: how long will the bay remain more or less the way it is and what are the factors that are effecting change. Studies were made to examine the present bathymetric configuration of Kaneohe Bay in terms of type and origin; to determine changes

in depth due to infilling or to erosion during the periods 1882 to 1927, and 1927 to 1969; and to examine sedimentation in the bay in terms of the nature of the sediment and the mechanisms and rates of sediment deposition. Author (GRA)

N72-11341# Geological Survey, Washington, D.C. Topographic Div.
**FULLY ANALYTICAL AEROTRIANGULATION BY THE DIRECT GEODETIC CONSTRAINT METHOD**
Morris L. McKenzie Jun. 1971 58 p refs
(PB-200861; USGS-TD-71-002) Avail: NTIS CSCL 08B

In fully analytical aerotriangulation, systematic errors are determined and removed mathematically, and then overlapping photographs are oriented and positioned to constraints mathematically. The end product is the positions and elevations of pass points for leveling and scaling steromodels during map compilation. Results are of a higher order of accuracy than is usually attained by semianalytical method. Research with superwide angle photographs is being conducted to increase the production rate for marking and measuring photograph images and to reduce the amount of required ground control. Author (GRA)

N72-11342# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**CONSIDERATIONS IN DEVELOPING AIR QUALITY CRITERIA**
F. Gordon Hueter, J. C. Romanovsky, and D. S. Barth Dec. 1970 9 p Presented at the Ann. Conf. on Environ. Toxicology (1st), Fairborn, Ohio, 9-11 Sep. 1970; sponsored by the SysteMed Corp.
(AD-727522; AMRL-TR-70-102-Paper-18) Avail: NTIS CSCL 13/2

In order that adequate background material be available for consideration by state officials responsible for adopting ambient air quality standards, the criteria documents are formulated to provide such comprehensive information. The report briefly summarizes the development of air quality criteria. Air quality criteria, therefore, are expected to describe the concentrations, exposure times, meteorological interactions, and other potentiating influences that are associated with health, welfare, or economic effects atributable, either directly to the contaminant in question, or to some analog of that contaminant. Air quality criteria include measurement methodology for rigorous application in determining the air quality. They also provide information on chemical contaminants in order to facilitate the rational development of control strategies. Author (GRA)

N72-11343# Westinghouse Research Labs., Pittsburgh, Pa.
**AN INTERNATIONAL ATTEMPT TO UNDERSTAND WIND GENERATED OCEAN WAVES. PART 2: SOME RESULTS Final Report, 15 Jan. 1970 - 15 Jun. 1971**
T. P. Barnett 15 Jun. 1971 73 p refs
(Contract N00014-68-0366; NR Proj. 083-220)
(AD-726720; Rept-71-9S1-OCEAN-P2) Avail: NTIS CSCL 08/3

Recent measurements by an international team of scientists have given the following tenative information on the mechanisms of wind wave generation and dissipation: From 30 - 90% of the observed wave growth is accounted for by the nonlinear wave-wave interaction theory of K. Hasselmann (1962, 1963). The simple interpretation of the equilibrium range by Phillips (1958) is not substantiated by the observation. The overshoot effect is clearly observed. From 10 - 20% of the momentum available from the atmosphere is advected with the wave field. Strong wave attenuation occurs in shallow water due to turbulent bottom friction. Secondary results are presented in the text. Author (GRA)

N72-11344# Oregon State Univ., Corvallis. Water Resources Research Inst.
**STUDY OF THE SOCIAL AND ECONOMIC EFFECTS OF CHANGES IN AIR QUALITY Annual Report, Jul. 1970 Jun. 1971**
R. Charles Vars and Gary W. Sorenson Jun. 1971 70 p
(Contract CPA-70-117)
(PB-201409; APTD-0696) Avail: NTIS CSCL 13B

A 2-phase research effort is summarized. The first phase is concerned with measurement of the economic changes consequent to the introduction of various air pollution control policies. The second phase deals with social effects. A theoretical model concerning the effects of air quality changes on peoples attitudes and mass media use patterns has been formulated as a means of measurement of change. Each of the objectives which relate to this model, are discussed. GRA

N72-11345# Battelle Memorial Inst., Columbus, Ohio.
**DESIGN OF AN ENVIRONMENTAL EVALUATION SYSTEM Final Report**
Ira L. Whitman, Norbert Dee, John T. McGinnis, David C. Fahringer, and Janet K. Baker 30 Jun. 1971 82 p
(Contract DI-14-06-D-7005)
(PB-201743) Avail: NTIS CSCL 13B

A proposed system for evaluating environmental impacts in the planning, design and construction of water resources projects is depicted. The evaluation system considers each project against a background of its effect on ecology, aesthetics, environmental pollution and human interest. GRA

N72-11346# California Univ., Berkeley. Earthquake Engineering Research Center.
**PRELIMINARY IN-SITU MEASUREMENTS OF ANELASTIC ABSORPTION IN SOILS USING A PROTOTYPE EARTHQUAKE SIMULATOR**
Roger D. Borcherdt and Peter W. Rogers Apr. 1971 37 p refs
(PB-201454; EERC-71-2) Avail: NTIS CSCL 08K

A preliminary investigation for determining the feasibility of using a controlled source to obtain in-situ measurements of anelastic absorption is reported. The controlled source used was a prototype earthquake simulator, designed for testing the servo-control system of one of the 50,000 lb. capacity hydraulic actuators of the medium scale facility. Results are useful for the design of future experiments using the medium scale facility and to provide an order of magnitude estimate for the anelastic absorption of the nearby soils. Author (GRA)

N72-11347# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
**MECHANICS OF CRUSTAL EARTHQUAKES**
William F. Brace, Pierre-Yves F. Robin, and Don K. Riley 1 Jun. 1971 48 p refs
(Contract bm-H0110376; ARPA Order 1579)
(AD-727346; DSR-72809-1) Avail: NTIS CSCL 08/7

Part I - The theory of stick-slip is developed, based on the concept of a static and dynamic coefficient of friction. The dynamic coefficient is assumed to be independent of displacement and to depend wholly on normal stress across the surface. It is also assumed to be velocity-independent. The theory predicts that the stress drop during stick-slip is independent of machine stiffness. The displacement during stick-slip is by contrast directly proportional to the machine compliance. Two series of experiments with different fault angles would serve to evaluate the dynamic coefficient of friction. Part II - Frictional sliding on sawcuts and faults in laboratory samples of various silicate rocks is markedly temperature-dependent. At pressures from 1 to 5 kb, stick-slip gave way to stable sliding as temperature was increased 200 to 500 C. The particular temperature of transition to stable sliding varied with rock type. Author (GRA)

N72-11348# Center for Naval Analyses, Arlington, Va.
**THE POLITICS OF OCEAN SCIENCE**
Robert L. Friedheim and Joseph B. Kadane Jun. 1971 50 p refs
(AD-726474; CNA-PP-50) Avail: NTIS CSCL 08/10

The United Nations General Assembly and its committee on the peaceful uses of the sea-bed are debating rules relating to the conduct of ocean science. The unsettled status of the law of the sea leads the less developed states to try to defend and expand their rights and to influence the use of ocean scientific discoveries. The paper measures the views of states on two broad questions: freedom of scientific research and the future of the Intergovernmental Oceanographic Commission, and estimates how science might fare in a future international attempt at legal regulation. Author (GRA)

N72-11349# Alaska Univ., College. Inst. of Marine Science.
**CHEMICAL CHARACTERISTICS OF ARCTIC WATER MASSES Technical Report, Mar. 1967 - Sep. 1970**
P. J. Kinney, D. C. Burrell, J. J. Kelley, and D. J. Hood 10 Nov. 1971 384 p refs
(Contract N00014-67-A-0317-0001)
(AD-727831; R69-15) Avail: NTIS HC $6.00/MF $0.95 CSCL 08/10

Technical progress is reported on the utilization of multiple chemical tracers to study the sources, movements, and mixing of Arctic Ocean water masses. A wide range in scale of mixing processes is considered, from the large scale general circulation to the small scale microstructure. Results of chemical characterization of major arctic water masses by routine chemical parameters are correlated and interpreted. Methodology for continuous processing of large volumes of water from any depth for recovery of large amounts (1 gram) of organic matter for subsequent Carbon-14 dating and chemical analysis has been developed. Finally, the detection of microstructure in the Arctic Ocean and the study of turbulent mixing processes associated with this small scale structure is discussed. Author (GRA)

N72-11350# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
**THE ROTATION RATE OF THE UPPER ATMOSPHERE: A NONLINEAR EFFECT Technical Report, Jun. 1970 - Jan. 1971**
Yam T. Chiu 2 Jun. 1971 27 p refs
(Contract F04701-70-C-0059)
(AD-725734; TR-0059(6260-10)-10; SAMSO-TR-71-110) Avail: NTIS CSCL 04/1

In order to study the apparent super-rotation of the earth's upper atmosphere, one examines a non-linear solution to the continuity, momentum conservation and state equations of gas dynamics for the steady state motion of a gravitationally stratified, cylindrical, inviscid atmosphere under the influence of a steady state, local time dependent temperature distribution. The resultant flow field can be understood in terms of angular momentum conservation of air masses; heated, rising air decreases its rotation rate and cooled, falling air increases its rotation rate. The local-time average of the differential rotation rate may give rise to an apparent altitude dependent super-rotation. Comparison with observations is presented. Author (GRA)

N72-11351# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1966**
John V. Evans 19 Jan. 1971 46 p refs
(Contract F19628-70-C-0230; DA Proj. 7X263304D215)
(AD-725742; TR-481; ESD-TR-71-7) Avail: NTIS CSCL 04/1

The report presents F-region electron densities and electron temperatures observed during the year 1966 at the Millstone Hill Radar Observatory (42.6 deg N, 71.5 deg W) by the UHF Thomson (incoherent) scatter radar. The measurements were usually made for periods of 24 hours twice per month, and covered the altitude range 150 to 750km approximately. The time required to collect all the measurements spanning this height interval was 30 minutes, i.e., half that of previous years. The results exhibit a greater amount of random time variation than seen heretofore, partly as a result of the better time resolution achieved and partly because each day has been analyzed individually, i.e., one has discontinued the practice of computing only the monthly mean behavior. The author believes, however, that the largest part of the random variation is real and results from fluctuations in the solar EUV flux, which increase in magnitude as the sunspot number rises. Also, the author expects a growing incidence of fluctuations produced by large-scale traveling ionospheric disturbances as one approaches sunspot maximum. Despite this variability, the characteristic winter and summer type behavior reported for Millstone in previous years is clearly recognizable. On four days in which pronounced effects due to geomagnetic storms are evident the layer rose to great heights in the late afternoon and achieved an abnormally high density (and lower-than-normal temperature). The reverse behavior was encountered the next morning. This sequence is similar to that first seen in June 1965, and its interpretation in terms of current ideas is summarized. Author (GRA)

N72-11352# Lamont Geological Observatory, Palisades, N.Y.
**INTERNATIONAL SYMPOSIUM ON MECHANICAL PROPERTIES AND PROCESSES IN THE MANTLE Final Report**
Lynn R. Sykes 14 Jun. 1971 22 p Symp. held at Flagstaff, Ariz., 24 Jun. - 3 Jul. 1970
(Grant AF-AFOSR-1948-70; AF Proj. 9731)
(AD-725769; AFOSR-71-1852TR) Avail: NTIS CSCL 08/7

A symposium on 'Mechanical properties and processes in the Mantle' was held in Flagstaff, Arizona, 29 June to 3 July 1970, under the auspices of the International Upper Mantle Project and US National Academy of Sciences. This was the first major upper mantle symposium held in the United States. The scope of the conference included physical properties of materials likely to be present in the mantle, rocks of possible mantle origin and their mode of emplacement, convection currents, and other possible driving forces of global tectonics. The conference was not intended to be a review of geophysical evidence for plate movements, but rather to seek out new directions influenced by these ideas. Author (GRA)

N72-11353# Aeronautical Chart and Information Center, St. Louis, Mo. Research Div.
**ON THE PORTRAYAL OF NATURAL RIVER VALLEY PHENOMENA ON SMALL-SCALE PHYSICAL MAPS [OB IZOBRAZHENII PRIRODNYKH YAVLENIY PO DOLINAM REK NA MELKOMASSHTABNYKH KARTAKH PRIRODY]**
T. V. Kotova and V. V. Maslennikova May 1971 10 p Transl. into ENGLISH from Geodeziya i Kartografiya, USSR, no. 12, 1970 p 61-64
(AD-725787; ACIC-TC-1739) Avail: NTIS CSCL 08/2

The paper discusses the problems concerning the principles of representation of valley contours on physical maps, particularly on small-scale geomorphological maps published for scientific reference purposes. Author (GRA)

N72-11354# Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Control Office.
**INTERSTATE SURVEILLANCE PROJECT: MEASUREMENT OF AIR POLLUTION USING STATIC MONITORS**
James H. Cavender, William M. Cox, Maurice Georgevich, Norman A. Huey, George A Jutze, and Charles E. Zimmer May 1971 159 p refs
(PB-200519; APTD-0686) Avail: NTIS CSCL 13B

The project was initiated with the following objectives: to obtain interstate, intrastate and international information on the types and degrees of air pollution in these areas and to provide information for later in-depth studies; to demonstrate the validity of the static monitor as a tool for measuring the effects of pollutants on materials, and to provide continuing surveillance to determine air pollution trends in these area. The basic structure, monitor components, and measuring capabilities of the monitoring unit are described. An informative discussion is given of the data tabulation of sampling results for all components of all stations. Evaluation of areas (which includes overall impact of pollution as well as the major pollution problems in the area) are presented. Project data evaluation is also given. GRA

N72-11355# Naval Postgraduate School, Monterey, Calif.
**AN EXPERIMENTAL METHOD OF DETERMINING BALLISTIC DENSITIES MAKING DIRECT USE OF SIRS RADIANCES Final Report, Jul. 1970 - Jan. 1971**
Russell L. Elsberry and Frank L. Martin 31 Jan. 1971 27 p refs
(AD-725484; NPS-51ES/MR71101A) Avail: NTIS CSCL 04/1

A technique for calculating ballistic density from Satellite Infrared Spectrometer (SIRS) radiance data is described. A model experiment in which radiance values are calculated from the temperature sounding is used to verify the technique. In a second experiment real-time SIRS radiances were used with synoptic and geographically-consistent soundings for evaluation of the ballistic density. For the limited data sample tested, the technique of computing ballistic densities from satellite radiances is capable of matching those computed from conventional radiosondes. Author (GRA)

N72-11356# Israel Program for Scientific Translations, Ltd., Jerusalem.
**SEMOLOGICAL INSTRUMENTS. NO. 5: INSTRUMENTATION FOR RECORDING SEISMIC PROCESSES [SEISMICHESKIE PRIBORY. NO. 5: APPARATURA DLYA REGISTRATSII SEISMICHESKIKH PROTSESSOV]**
E. S. Borisevich and D. P. Kirnos, eds. 1971 195 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Fiz. Zemli, Seismicheskie Pribory, no. 5, 1969 170 p Prepared for NSF and ESSA
(TT70-50019) Avail: NTIS

Descriptions are presented of general-purpose modernized seismographs and of a new unified method for determining and adjusting the constants of these instruments. Author (GRA)

N72-11357# Ohio State Univ., Columbus. Dept. of Geodetic Science.
**THE DIRECT COMBINATION OF SATELLITE AND GRAVIMETRIC DATA FOR MEAN ANOMALY DETERMINATION**
Richard H. Rapp Jan. 1971 65 p refs
(Contract F19628-69-C-0127; AF Proj. 7600; SURF Proj. 2758A)
(AD-726113; DGS-131; SR-13; AFCRL-71-0068; Task-7600-02; Task-7604-01) Avail: NTIS CSCL 08/5

The computation of the external gravitational field of the earth from satellite analysis and its subsequent combination with terrestrial gravity data has been usually done with spherical harmonic potential coefficients representing the earth's gravitational potential. This paper examines the theory of the problem when the gravity field of the earth is represented by discrete blocks on the surface of the earth. Gravity anomalies in these blocks now become the unknown parameters being sought. The determination of such anomalies is discussed as well as the procedure for directly combining terrestrial gravity information with this new type of satellite analysis. Results from a simulation study are given along with recommendations for the improvement of the tested method. Although no real data is used in the study, procedures are outlined in the case real data is to be used. Author (GRA)

N72-11358# Sea Farm Research Foundation, Inc., Waltham, Mass.
**INVESTIGATION OF GEOMAGNETIC FIELD VARIATIONS AND RELATED MAGNETOSPHERIC PHENOMENA Final Report, 6 Oct. 1969 - 13 Oct. 1970**
John H. Frey, William L. Fischer, and David L. Miller 30 Nov. 1970 80 p refs
(Contract F19628-70-C-0081; AF Proj. 8601)
(AD-726110; AFCRL-70-0654) Avail: NTIS CSCL 08/14

Geomagnetic variations with periods ranging from 0.02 seconds to several days have been investigated to ascertain their nature and origins and their relationship to other magnetospheric phenomena. This investigation included the study of local time variation in geomagnetic micropulsations, the study of the average energy of the micropulsation spectrum in six contiguous octave bands, and the comparison of main geomagnetic field variations with the interplanetary magnetic field. Error analysis of spherical harmonic expansions of solar quiet daily variation, Sq, of the earth's main field has been completed. Author (GRA)

N72-11359# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
**THE DETERMINATION OF GRAVITATIONAL POTENTIAL FROM THE MEASUREMENT OF RELATIVE VELOCITY BETWEEN SATELLITES Ph.D. Thesis**
Gary Christopher Comfort Jun. 1971 156 p refs
(Contract F04701-69-C-0123; DSR Proj. 52-33722)
(AD-726122; T-545) Avail: NTIS CSCL 08/5

The detailed characteristics of the gravitational potential of the earth are not generally known due to the difficulty of making continuous global measurements. The continuous on-board measurement of relative velocity between two satellites in the same nominally circular polar orbit but separated by a small central angle is investigated. It is shown that this measurement of relative velocity along the line of sight between the co-orbiting satellites directly measures the difference in kinetic energies between the satellites. The short period components of this measurement can be interpreted as a direct measure of the short wavelength portion of the disturbing potential encountered along the nominal orbit. This allows the direct mapping of the short wavelength anomalies in the potential encountered along the nominal orbit of the satellite pair. In addition, the representation of this short wavelength portion of the potential in terms of a spherical harmonic model is considered. A method is developed to accurately recover the zonal harmonic coefficients of degree greater than ten in that expression for the earth's potential. The difficulties in recovering tesseral harmonic coefficients are discussed. The actual implementation of the satellite pair measurement scheme is investigated and found to be feasible. Author (GRA)

N72-11360# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
**OPTICAL PROPERTIES OF THE ATMOSPHERE**
R. A. McClatchey, R. W. Fenn, F. E. Volz, J. S. Garing, and J. E. A. Selby 10 May 1971 100 p refs Revised
(AF Proj. 7670)
(AD-726116; AFCRL-71-0279; AFCRL-ERP-354) Avail: NTIS CSCL 04/1

A series of tables and charts is presented from which the atmospheric transmittance between any two points in the terrestrial atmosphere can be determined. This material is based on a set of five atmospheric models ranging from tropical to arctic and two aerosol models. A selected set of laser frequencies has been defined for which monochromatic transmittance values have been given. For low resolution transmittance prediction, a series of charts has been drawn providing the capability for predicting transmittance at a resolution of 20 wave numbers. Separate sections are included on scattered solar radiation, infrared emission, refractive effects, and attenuation by cloud and fog. Author (GRA)

N72-11725*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SHORT TIME-SCALE OPTICAL PULSATIONS IN THE NIGHT SKY BACKGROUND**
D. L. Bertsch, A. Fisher, and H. Ogelman *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 47-52 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

# 14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

**N72-11361** National Lending Library for Science and Technology, Boston Spa (England).
**HIGH DERIVATIVE FERROSONDES ON A SINGLE CORE [FERROSONDES VYSSHIKH PROIZVODNYKH NA ODNOM SEREDECHNIKE]**
M. P. Afanasenko, R. Ya. Berkman, and Kh. K. Osyka Oct. 1971 9 p refs Transl. into ENGLISH from Otbor i Peredacha Inform. (USSR), no. 22, 1969 p 74-81
(NLL-RTS-6694) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.90; 3 NLL photocopy coupons

The possibility of constructing high derivative ferrosondes on one common core is demonstrated and their theoretical characteristics are described. Theoretical relationships for determining the parameters of the probes for use under direct measurement and self-compensating conditions are derived and the numerical values of the correction coefficients to the degree of immunity to interference are determined from point sources of the desired signal and noise. Author

**N72-11362** National Lending Library for Science and Technology, Boston Spa (England).
**CONSTRUCTION OF RESPONSE MATRICES IN GAMMA-SCINTILLATION SPECTROMETRY**
R. Brust and D. Richter 7 Sep. 1971 24 p refs Transl. into ENGLISH from Nucl. Instrum. Methods (Netherlands), v. 81, 1970 p 132-140
(NLL-LB/G/3075-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The use of an inverse response matrix to unfold pulse height distributions gives rise to difficulties which appear in the unfolded spectra as distrubing oscillations. An attempt is made to construct a response matrix with an accuracy as high as possible and to demonstrate in this way the influence of this accuracy on the results of the unfolding prcedure in comparison with disturbing sources which furthermore occur. Besides a high number of monoenergetic spectra, additional information is used from the experimental spectra. The unfolding of pulse height distribution shows, that the inversing method is well suitable to work up continuous energy distributions, even if these spectra are superimposed by a discrete line spectrum. Also, it is shown that the unfolding of spectra with several lines which have a sufficiently high distance in energy, each from the other, is possible with a sufficient accuracy in many cases. Author

**N72-11363*** TRW Systems Group, Redondo Beach, Calif.
**RESONANT INFRASONIC GAUGING APPARATUS** Patent
Bernard Siegel and Seymour Lieberman, inventors (to NASA) Issued 3 Aug. 1971 6 p Filed 4 Feb. 1970 Sponsored by NASA Supersedes N70-26814 (08 - 13, p 2383)
(NASA-Case-MSC-11847-1; US-Patent-3,596,510;
US-Patent-Appl-SN-8497; US-Patent-Class-73-149;
US-Patent-Class-73-290B) Avail: US Patent Office CSCL 14B

An apparatus for determining the quantity of liquid in a closed reservoir containing a liquid and an ullage gas is described. An enclosed gas filled cavity communicates with the reservoir through a common elastomeric diaphragm surface. Infrasonic pressure signals directed into the cavity from a variable frequency driving means cause the ullage gas and the diaphragm to resonate at a frequency proportional to the volume of ullage gas in the reservoir. The ullage volume and the remaining liquid volume is proportional to the ullage gas pressure and the resonant frequency.
Official Gazette of the U.S. Patent Office

**N72-11364*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**APPARATUS FOR REMOTE MEASUREMENT OF DISPLACEMENT OF MARKS ON A SPECIMEN UNDERGOING A TENSILE TEST** Patent
Robert H. Silver, inventor (to NASA) Issued 13 Jul. 1971 4 p Filed 13 Oct. 1969 Sponsored by NASA Supersedes N70-34629 (08 - 18, p 3354)
(NASA-Case-NPO-10778; US-Patent-3,592,545;
US-Patent-Appl-SN-865909; US-Patent-Class-356-32;
US-Patent-Class-33-125; US-Patent-Class-73-95;
US-Patent-Class-356-167; US-Patent-Class-250-235) Avail: US Patent Office CSCL 14B

A description is given of the apparatus and the methodology employed in its use. One or more optically contrasting marks are placed on a test specimen and illuminated while the specimen undergoes testing. The field of marks, which may include a stationary reference mark, is scanned with an optical system to detect the marks and generate an electrical pulse in response to each mark scanned. The position of each pulse with respect to a reference is then determined graphically or electronically to measure the displacement of a given mark.
Official Gazette of the U.S. Patent Office

**N72-11365*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**NUCLEAR MASS FLOWMETER** Patent
Thomas N. Marshall, Jr., inventor (to NASA) Issued 17 Aug. 1971 4 p Filed 24 Mar. 1970 Supersedes N70-26800 (08 - 13, p 2383)
(NASA-Case-MFS-20485; US-Patent-3,599,489;
US-Patent-Appl-SN-22320; US-Patent-Class-73-194F;
US-Patent-Class-250-43-5FC) Avail: US Patent Office CSCL 14B

A flowmeter, utilizing a beta source positioned upstream of a cylindrical capacitor formed by two spaced-apart concentric cylindrical sections is reported. The concentric cylindrical sections form the capacitor electrodes and are a part of two concentric, inner and outer, tubular members which are mounted in an outer housing that is adapted to be connected into a flow line so that fluid flows through both the inner and outer tubular members. The capacitor electrodes are insulated from tubular members by means of dielectric ring members connected therebetween. Means are provided for detecting any potential difference between the two electrodes and for evacuating the space between the outer tubular member and the housing.
Official Gazette of the U.S. Patent Office

**N72-11366#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**PROCEDURE MANUAL FOR THE DEPARTMENT OF ELECTRON MICROSCOPY. 4: THIN SECTIONING. THE ELECTRON MICROSCOPES [RICETTARIO AD USO DEL REPARTO DI MICROSCOPIA ELETTRONICA. 4: ULTRAMICROTOMIA. I MICROSCOPI ELETTRONICI]**
8 Apr. 1970 85 p refs In ITALIAN; ENGLISH summary
(ISS-70/10) Avail: NTIS

The preparation of thin section specimens, and the procedures for using the Siemens and AEI electron microscopes are described. Transl. by F.O.S.

**N72-11367#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**ELECTRO-OPTICAL DETECTORS FOR MAGNETIC SUSPENSION AND THE STUDY OF THE FREE MOTION OF MODELS [DETECTEURS ELECTRO-OPTIQUES POUR SUSPENSION MAGNETIQUE ET POUR L'ETUDE DU MOUVEMENT LIBRE DE MAQUETTES]**
Roland Moreau, Jean Besson, and Roland Hoarau 1971 14 p refs Presented at Symp. on Electromagnetic Suspension, Southampton, Engl., 12-14 Jul. 1971
(ONERA-TP-988) Avail: NTIS

During the development of a magnetic suspension system



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for wind tunnel testing, a remote position sensor was designed. Scanning analysis of optical contrasts was applied directly to the model. Author

N72-11368# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**STUDY AND CALIBRATION OF PRESSURE SENSORS IN PARTICULAR ENVIRONMENTS [ETUDE ET ETALONNAGE DE CAPTEURS DE PRESSIONS EN AMBIANCES PARTICULIERES]**
Bernard Baerd, Alain Julienne, and Rene Nantois 1971 5 p refs In FRENCH Presented at the 7th Intern. Congr. on Acoustics, Budapest, 18-26 Aug. 1971
(ONERA-TP-982) Avail: NTIS

The design and calibration of unsteady pressure sensors used to measure aerodynamic noise are discussed. The sensitivity of the sensors under difficult environmental conditions such as high noise levels, surrounding flow, static overpressure, vibrations, and high temperature are determined. The sensors are also designed to measure the effects of turbomachine interior and jet interior on pipe flow. Author

N72-11369*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A FAST ELECTRON GUN FOR STUDY OF ATOMIC DECAYS**
John F. Sutton Sep. 1971 13 p Submitted for publication
(NASA-TM-X-65737; X-325-71-393) Avail: NTIS CSCL 14B

A fast electron gun with subnanosecond rise- and decay-times and 100 ma. peak beam current has been developed for delayed coincidence studies of atomic decays. The gun is fabricated from an inexpensive tetrode Nuvistor, involving only slight modification. Author

N72-11370# Civil Aeromedical Inst., Oklahoma City, Okla.
**CALIBRATION OF THE CONCORDE RADIATION DETECTION INSTRUMENT AND MEASUREMENTS AT SST ALTITUDE**
Wallace Friedberg and John M. Nelson Jun. 1971 21 p refs
(FAA-AM-71-26) Avail: NTIS

Performance tests were carried out on a solar cosmic radiation detection instrument developed for the Concorde SST. The instrument calibration curve was reasonably linear from 0.004 to 1 rem/hr for both gamma radiation and fast neutrons. Nonlinearity in the calibration curve was observed at dose rates below 0.003 rem/hr. The instrument responded normally after exposure to 30 rem/hr of gamma radiation. The charged particle detectors showed a directional response because of the neutron moderator. The neutron detector did not show a directional response. Measurements made with the Concorde instrument at 60,000 ft and high geomagnetic latitudes indicated a galactic cosmic radiation dose rate of 0.7-0.9 millirem/hr. Author

N72-11371*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**METEOROID DETECTOR Patent Application**
Leonard R. McMaster, Sheldon T. Peterson, and Frank M. Hughes, inventors (to NASA) Filed 27 Sep. 1971 8 p
(NASA-Case-LAR-10483-1; US-Patent-Appl-SN-184090) Avail: NTIS CSCL 14B

Use of a cold-cathode discharge tube with a gas-pressurized cell for recording a meteoroid puncture of the cell and for determining the size of the puncture. NASA

N72-11372*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**VEE NOTCHING DEVICE Patent Application**
Raymond A. Spier, inventor (to NASA) Filed 23 Sep. 1971 11 p
(NASA-Case-MFS-20730; US-Patent-Appl-SN-182977) Avail: NTIS CSCL 14B

A device for forming Vee-notches in tensile test specimens comprising a vertically reciprocating, triangular, triple-edged cutting tool guided in a corresponding triangular slot is reported. The specimen to be vee-notched is mounted on a carriage, that is movable toward and away from the cutting tool. The specimen is precisely positioned on the carriage by tapered studs that extend into holes in the specimen and are used to expand spring collets against the wall of the holes. NASA

N72-11373*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**ON-FILM OPTICAL RECORDING OF CAMERA LENS SETTINGS Patent Application**
Richard E. Thompson, inventor (to NASA) Filed 17 Mar. 1971 15 p
(NASA-Case-MSC-12363-1; US-Patent-Appl-SN-125236) Avail: NTIS CSCL 14E

An apparatus is described for recording a representation of the camera lens aperture and focus setting on the film of a camera, while the photographic image is being recorded. A data lens is provided between the camera lens and film, by means of which the aperture and focus setting of the camera lens may be determined, based on measurement of the location and the size of a data image provided by the data lens. Such a lens method requires no electrical power, is low in weight, and does not result in an increase in the external dimensions of the camera. NASA

N72-11374*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHOD OF MAKING APPARATUS FOR SENSING TEMPERATURE Patent Application**
Ronald G. Huff, inventor (to NASA) Filed 26 May 1971 10 p
(NASA-Case-XLE-05230-2; US-Patent-Appl-SN-147099) Avail: NTIS CSCL 14B

A description is given of a thermocouple device used to measure the wall surface temperature on the hot side of a thin walled cooling passage. The measurements were made on regeneratively cooled passages of rocket engines. The measuring of such temperatures without disturbing adjacent boundary layers, was emphasized. Author

N72-11375# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
**A THREE COMPONENT GUN TUNNEL BALANCE DESIGNED FOR TESTING THIN DELTA WINGS**
T. Opatowski Aeron. Res. Council 1971 36 p refs Supersedes ARC-31278
(ARC-R/M-3664; ARC-31278) Avail: NTIS; HMSO: 95p; BIS: $3.60

The design, development, and performance of a three component strain gage balance system designed for testing thin wings in a gun tunnel is described. The balance was machined out of high strength steel and employed miniature silicon strain gages on tension and compression links in order to meet the difficult strength/stiffness requirements. Natural frequencies were attenuated with parallel T filters. Various problems which arose in its development were successfully overcome and some excellent results were obtained. Author (ESRO)

N72-11376# California Univ., Livermore. Lawrence Radiation Lab.
**ROCKET-BORNE CELESTIAL X-RAY PROPORTIONAL COUNTER SYSTEM**
G. A. Burginyon, C. M. Cornell, H. W. Dalbol, T. C. Erven, R. J. Grader, R. W. Hill, A. Iantuono, J. B. Stoering, and J. R. Zickuhr 2 Feb. 1971 20 p refs
(Contract W-7405-eng-48)
(UCRL-51007) Avail: NTIS

Characteristics of a new, sensitive broad-range thin-window gas-flow proportional counter system, designed primarily for the detection of low-energy X-rays in rocket-borne experiments, are

presented. A space-conserving, two-gas stacked concept is utilized: a methane-filled front counter is put on top of an argon-filled back counter. A single eggcrate, charged-vane collimator with a voltage on alternate vanes to eliminate background from cosmic electrons defines entry into both counters. Instruments are calibrated with a portable characteristic X-ray emitter, which was developed especially for this purpose for energies between 0.2 and 10 keV. Some comments on its operation and performance are included. Author (NSA)

N72-11377# Union Carbide Corp., Oak Ridge, Tenn.
**EDDY CURRENT DISTANCE GAGE FOR PRECISE STATIC MEASUREMENTS**
J. F. Ellis 2 Aug. 1971 26 p refs
(Contract W-7405-eng-26)
(Y-1793; UC-37) Avail: NTIS

An eddy-current gage for proximity measurements has been designed which employs a self-contained, high-stability, inductance-capacitance oscillator to produce an output signal whose frequency is related to the separation between a resonant coil and a conducting surface. A typical 5/8-inch-diameter probe can resolve a mechanical displacement of one microinch at a separation of 40 mils, and a typical two-inch probe will resolve a displacement of 50 microinches at a separation of one inch. The device is insensitive to dielectric materials and is useful for a variety of gaging applications including those performed under oil or water. Author (NSA)

N72-11378# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
**PRECISION FLOW-MONITORING SPECTROMETER WITH LOW NOISE AND HIGH STABILITY**
Brian A. Bidlingmeyer and Stanley N. Deming [1970] 13 p refs
(Contract AT(11-1)-1222)
(COO-1222-45) Avail: NTIS

A modification to a Bausch and Lomb Spectronic 20 spectrometer that results in a durable, inexpensive, high-precision, flow-monitoring detector is described. The system employs optical feedback to maintain the source intensity at a constant level. The utility of the spectrometer is illustrated with the detection of methyl orange eluted from a chromatographic column. F.O.S.

N72-11379# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
**EFFECT OF LOADING ON SEPARATION EFFICIENCY USING STERIC EXCLUSION CHROMATOGRAPHY**
T. A. Maldacker and L. B. Rogers [1970] 19 p refs
(COO-1222-46) Avail: NTIS

Resolution and resolution-per-unit-time were studied for columns from 4 to 21 mm. I.D. The effects of sample size, particle diameter, and linear flow rate were determined. Greatest resolution was obtained for the largest diameter column, and it was attributed to a loading effect. In a related study, efficiency was examined as a function of column diameter for a constant amount of gel and a constant retention time. The narrower columns gave more plates, but their HETP values were also greater. Author

N72-11380# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
**SERVO SYSTEM FOR VIBRATION TESTS AT FIXED FREQUENCY [ASSERVISSEMENT POUR ESSAI DE VIBRATIONS A FREQUENCE FIXE]**
B. Sannier 13 Jul. 1971 11 p In FRENCH
(LRBA-NT-15/71/DAF) Avail: NTIS

A device for automatic frequency control in long duration vibration testing at resonant frequencies is described, and its performance is discussed. Control of generator frequency drift was achieved automatically using a technique of phase feedback. The generator could provide frequencies in two ranges: 0.5 to 500 Hz and 5 to 5000 Hz. ESRO

N72-11381# New York Univ., N.Y. Research Division
**SPECTRUM ANALYZERS**
Jack Lustig Jun. 1971 138 p refs
(Contract N00039-68-C-3579; Proj. XF013-17-01)
(AD-725175) Avail: NTIS CSCL 14/2

The report consists of a discussion of various kinds of Spectrum Analyzers used in electronics and of a compilation of the electrical characteristics of commercial and nomenclatured instruments. The commercial instrument characteristics are based upon catalogs, manufacturers data sheets and statements by manufacturers in response to requests for information. Of special interest in this report are the communications RF single-side band and low frequency spectrum analyzers.
Author (GRA)

N72-11382# Idealab, Inc., Franklin, Mass.
**ONE METER STEPPING INTERFEROMETER Final Report, 5 Feb. 1968 - 31 Dec. 1970**
Feb. 1971 116 p
(Contract F19628-68-C-0154; AF Proj. 8603)
(AD-725779; AFCRL-71-0173; Task-860301) Avail: NTIS CSCL 20/6

The report summarizes the design and construction of a two meter path difference Fourier Transform Spectrometer. Optical layout and mechanical design problems are discussed and a description of the electronic control unit is included.
Author (GRA)

N72-11383# California Univ., La Jolla. Scripps Inst. of Oceanography.
**AUTONOMOUS DEEP-SEA CINE SYSTEM**
Richard L. Shutts and Meredith H. Sessions 1971 5 p refs Presented at the SPIE 15th Ann. Techn. Symp. Anaheim, Calif., Sep. 1970
(Contract AT(11-1)-34)
(UCSD-34-P-127-10) Avail: NTIS

A deep-sea cine camera system was developed for recording activity on the ocean floor using preset durations and time intervals. The autonomous, compact system is employed to observe deep benthic organisms and their movements. It freely descends to the ocean floor, where it is maintained by a ballast weight with attached bait. The creatures are lured into the camera's field of view by a bait and are photographed. At a preselected time, the camera system is separated from its ballast and ascends to the surface for recovery. Film has shown large numbers of active organisms to depths of 20,000 feet including large predators. Author

# 15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-11384 National Lending Library for Science and Technology, Boston Spa (England).
**DEVELOPMENT OF A TECHNOLOGY FOR THE HIGH-SPEED STAMPING OF BLADE BLANKS [RAZRABOTKA TEKHNOLOGICHESKOGO PROTSESSA VYSOKOSKOROST-NOGO VYDAVLIVANIYA ZAGOTOVOK LOPATOK]**
A. N. Zhuchenko and Yu. P. Sogrishin Aug. 1971 26 p refs Transl. into ENGLISH from Eksperim. Nauchn. Issled. Inst. Kuznechno-Presovogo Mashinostr. (Moscow), no. 21, 1969 p 29-59
(NLL-RTS-6447) Avail: Natl. Lending Library, Boston Spa, Engl.: £2.60 or 9 NLL photocopy coupons

It has been established that the high-speed stamping of

blade blanks with hammers has the following advantages over stamping in a press: the conditions for metal flow are more favorable; this makes it possible to stamp blades with lower allowances and tolerances; the thin edges of the blade tip are better filled owing to inertia and to improvement in the thermal stamping conditions; and the die is better resistant to crumpling. It has been determined that the individual blade factors can be deduced: the coefficient of elongation may not exceed 10-15, the wedge angle 6 deg, the edge radii up to 0.3 mm, and the angle of twist up to 55 deg. The quality of the stamped blade blanks is satisfactory. The plastic properties of the stamped blades are 50-100% higher than those of cast blades. Author

**N72-11385*** North American Aviation, Inc., Canoga Park, Calif.
**SAFETY-TYPE LOCKING PIN Patent**
Ture E. Othman, Ervin P. Nelson, and Lawrence J. Zmuda, inventors (to NASA) Issued 3 Aug. 1971 4 p Filed 19 May 1970 Sponsored by NASA Supersedes N70-35565 (08 - 19, p 3548)
(NASA-Case-MFS-18495; US-Patent-3,596,554; US-Patent-Appl-SN-38814; US-Patent-Class-85-5B; US-Patent-Class-24-211N) Avail: US Patent Office CSCL 13E

A safety-type locking pin for joining two load-carrying members and including means for preventing removal of the pin unless the pin is free of load is described. A slidable plunger moves between a locked and unlocked position of the pin by plunger actuation of detent balls. The plunger is spring-urged toward the locked position. A handle on the end of the pin opposite the detent balls is slidable against a spring to a position that interferes with the plunger being maintained in the unlocked position that is necessary to remove the pin. However, if the pin is free of load, and thus withdraws easily from the joined members, the pin will withdraw from the members and the handle will not shift to the interfering position. Author

**N72-11386*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**FINE ADJUSTMENT MOUNT Patent**
Walter E. Kaspareck, inventor (to NASA) Issued 3 Aug. 1971 4 p Filed 28 Jan. 1969
(NASA-Case-MFS-20249; US-Patent-3,596,863; US-Patent-Appl-SN-794530; US-Patent-Class-248-278; US-Patent-Class-33-72; US-Patent-Class-248-183; US-Patent-Class-248-487; US-Patent-Class-350-285; US-Patent-Class-350-287) Avail: US Patent Office CSCL 13E

A mount for optical devices is described. It is formed with a horizontal slot or cutout, a longitudinal slot, and a vertical slot, leaving only a small bridgelike portion between adjacent members. This last serves as a spring against an adjusting screws, associated with pair of the members forming a slot. The most forward member adjacent to the longitudinal slot has cantilevered arms to support the optical device.
Official Gazette of the U.S. Patent Office

**N72-11387*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**METHOD OF MAKING FOAMED MATERIALS IN ZERO GRAVITY Patent**
Hans F. Wuenscher, inventor (to NASA) Issued 13 Jul. 1971 4 p Filed 22 Oct. 1960
(NASA-Case-XMF-09902; US-Patent-3,592,628; US-Patent-Appl-SN-769665; US-Patent-Class-75-20F) Avail: US Patent Office CSCL 13H

A method of making homogeneous foamed materials by mixing two or more materials having different physical properties in a zero-gravity environment is presented. The materials are stored as liquids, gases and solids, the solid materials being in particles like powders and fibers. When making a homogeneous solid structure from two or more materials the solid materials are heated to change the state of one or more of the materials to a liquid for mixing. A foamed material can be made by decomposition of one material in a liquid or by injection of an inert gas into a liquid. Inert gas can also be injected into a homogeneous mixture of a liquid and solid particles. The mixture is then agitated so as to form a homogeneous mixture of solids in liquids or gases in liquids. Due to the absence of gravity forces, it is possible to uniformly disperse solid particles or a gas within a liquid and there is no tendency to separate out since settling of the heavier materials is eliminated. Author

**N72-11388*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**AIR BEARING ASSEMBLY FOR CURVED SURFACES Patent**
John W. Redmon, inventor (to NASA) Issued 17 Aug. 1971 5 p Filed 10 Oct. 1969 Supersedes N70-22251 (08 - 09, p 1642)
(NASA-Case-MFS-20423; US-Patent-3,600,046; US-Patent-Appl-SN-865298; US-Patent-Class-308-5; US-Patent-Class-212-134) Avail: US Patent Office CSCL 13I

A journal air bearing is described with cylindrical cup designed to ride on a shaft. The bearing is split into two halves with a round groove that conforms to the shape of the shaft, and are connected by an adjustment mechanism that maintains a particular spacing between the two halves. Each bearing half has an air manifold connected to a source of pressurized air so that an air film is maintained between the surface of the bearing and the surface of the shaft.
Offical Gazette of the U.S. Patent Office

**N72-11389*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**FLARED TUBE STRAINER Patent**
Otis J. Parker, inventor (to NASA) Issued 13 Jul. 1971 3 p Filed 23 Nov. 1966
(NASA-Case-XLA-05056; US-Patent-3,592,768; US-Patent-Appl-SN-596733; US-Patent-Class-210-445) Avail: US Patent Office CSCL 13I

A strainer for a flared tube fitting is described. The strainer has a filtering portion which fits within the tube. A fitting is secured to the filtering portion and is flared to match the tube flaring. The flared portion of the fitting is clamped between the tube and a connector positioning and fixing the strainer in the tube. Author

**N72-11390*** North American Rockwell Corp., Canoga Park, Calif.
**NONCONTAMINATING SWABS Patent**
Martin Fritzen, Jr., inventor (to NASA) Issued 13 Jul. 1971 4 p Filed 16 Dec. 1968 Sponsored by NASA
(NASA-Case-MFS-18100; US-Patent-3,591,885; US-Patent-Appl-SN-784055; US-Patent-Class-15-210; US-Patent-Class-15-143) Avail: US Patent Office CSCL 13I

A noncontaminating swab is described which was designed to prevent the egress of absorbent materials by providing a protective covering. The swab comprises an applicator handle with at least one end having a wad of fibrous material attached which is surrounded and entrapped by an envelope of woven or porous fabric. The fabric is sealed at one end, slipped over the absorbent material, and secured to the handle below the base of the material. The fabric may be secured to the applicator stick with a length of heat shrinkable polymeric material or it may be fused by a heating process. D.L.G.

**N72-11391*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**VIBRATION ISOLATION SYSTEM USING COMPRESSION SPRINGS Patent**
Robert M. Norman, inventor (to NASA) Issued 13 Jul. 1971 5 p Filed 29 Jul. 1969 Sponsored by NASA Supersedes N70-11133 (08 - 01, p 104)
(NASA-Case-NPO-11012; US-Patent-3,592,422; US-Patent-Appl-SN-845807; US-Patent-Class-248-18; US-Patent-Class-248-20) Avail: US Patent Office CSCL 13I

A vibration isolation system for isolating loads from vibrational force effects transmitted to supporting structures is

described. This system is characterized by a plurality of suspension members, each of which includes a pair of coaxially arranged, helical compression springs.

Official Gazette of the U.S. Patent Office

**N72-11392*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**STUD-BONDING GUN** Patent

William G. Simpson and Billy K. Davis, inventors (to NASA) Issued 13 Jul. 1971 6 p Filed 31 Dec. 1969 Supersedes N70-35596 (08 - 19, p 3548)

(NASA-Case-MFS-20299; US-Patent-3,593,001; US-Patent-Appl-SN-889437; US-Patent-Class-219-243; US-Patent-Class-156-66; US-Patent-Class-156-320; US-Patent-Class-219-221) Avail: US Patent Office CSCL 13I

A tool for mounting and removing studs having an adhesive coated head portion and a stem is described. The tool includes an outer housing with attached handle and a stud-receiving means mounted in the housing. The stud-receiving means includes a heater for softening the adhesive on the stud, a locking device for releasably holding the stud in the tool, and ejection means for ejecting the stud toward a mounting surface when the locking means is released. Electrical contact elements mounted in the housing are actuated when pressed against the mounting surface. The contact elements are connected in series with the trigger switch to prevent release of the locking means unless the contact elements are properly actuated. This assures proper positioning of the tool with respect to the mounting surface. A heat-sensing device is provided for monitoring the temperature of the stud head portion.

Official Gazette of the U.S. Patent Office

**N72-11393#** Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).

**SCHEDULES AND LOT SIZES IN SERIES MANUFACTURING STUDIED BY A PRACTICAL SIMULATION MODEL Ph.D. Thesis [REIHENFOLGEN UND LOSGROESSEN IN DER SERIENFERTIGUNG UNTERSUCHT AN EINEM PRAXISBEZOGENEN SIMULATIONSMODELL]**

Axel J. Papendieck 1971 152 p refs In GERMAN

Avail: NTIS

Simulation models for scheduling and lot size in multiple step series production show that the use of priority rules does not affect developing costs. Planning methods produce only in very limited situations good results when high value lots are processed rapidly through production. The latter process is only recommended when the additional administrative effort remains reasonable. Simulation of optimal lot size shows that work with smaller lots is most advantageous. Minimal expenses occur with lot sizes between half and whole Adler values in relation to the cost value of the product. Minimal cost effectiveness is found approximately at a capacity limit represented in 100% occupation of a working group; exceeding this limitation produces rapidly increasing costs and organizational difficulties. Transl. by G.G.

**N72-11394*#** Scientific Translation Service, Santa Barbara, Calif.

**BRAZING INOXIDIZABLE STEELS AND CHROMIUM MATERIALS IN A STABLE REDUCING-FLUORIDATED ATMOSPHERE [BRASAGE DES ACIERS INOXYDABLES ET DES MATERIAUX AU CHROME EN ATMOSPHERE REDUCTRICE FIUOREE A L'EQUILIBRE]**

Philippe Galmiche Washington NASA Nov. 1971 16 p refs Transl. into ENGLISH of French report ONERA-171

(NASA-TT-F-14040; ONERA-171) Avail: NTIS CSCL 13H

Techniques for brazing inoxidizable steels and chromium materials in a stable reducing-fluorinated atmosphere are described. The principle, operational conditions, limitations, and applications of the brazing technique are presented. It is concluded that the technique makes it possible to accomplish metal joining operations which were not possible previously.

Author

**N72-11395*#** Northwestern Univ., Evanston, Ill.

**THE PRESSURE AND DEFORMATION PROFILE BETWEEN TWO COLLIDING LUBRICATED CYLINDERS**

Kwan Lee and H. S. Cheng Washington NASA Nov. 1971 97 p refs

(Grant NGL-14-007-084)

(NASA-CR-1944) Avail: NTIS CSCL 20K

The pressure and deformation profiles between two colliding lubricated cylinders are obtained by solving the coupled, time-dependent elastohydrodynamic equations with an iterative procedure. The analysis includes effects which were not considered in a previous solution, namely, the effect of the lubricant compressibility and the effect of a lubricant with composite pressure-viscosity coefficients. It is found that the local approach velocity plays an important role during final stages of normal approach. It causes the lubricant to be entrapped within the contact region; neither the pressure nor the deformation profile converges to the Hertzian profile for a dry contact. The use of a smaller pressure-viscosity coefficient at high pressures reduces the sharp pressure gradient at the center of the contact and produces a much milder variation of load with respect to the film thickness. The effect of compressibility of the lubricant is found to be relatively small.

Author

**N72-11396*#** Electro-Optical Systems, Inc., Pasadena, Calif.

**COMPOSITION AND METHOD FOR ELECTROFORMING ALUMINUM SUBSTRATES** Patent Application

John A. Carlson and Kunneth Lui, inventors (to NASA) Filed 3 Feb. 1971 18 p

(Contract NAS7-428)

(NASA-Case-NPO-12090; US-Patent-Appl-SN-112365) Avail: NTIS CSCL 13H

An electrolytic bath and technique for electroforming large area foil structures and particularly a hollow core aluminum substrate for a lightweight solar panel are discussed. The electrolytic bath includes an amount of at least 0.3 molar up to about 1.0 molar and a mixture of an aromatic and aliphatic ether preferably containing at least 10% to about 60% aromatic ether, suitably about one-third aromatic ether. Improved plating is obtained by recirculating and filtering the plating bath, controlling the temperature of the bath between about 10 C and about 30 C and controlling the current density between about 10 to 25 amperes per square foot.

Author

**N72-11397#** Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

**MACHINING OPTIMIZATION**

L. A. Abbatiello (Soc. of Mfg. Engr.), C. H. Thompson (Soc. of Mfg. Engr.), and R. L. Williams Dearborn, Mich. Soc. of Mfg. Engr. [1971] 13 p For presentation at its Creative Mfg. Engr. Programs, the SME Intern. Conf., Philadelphia, (26 Apr. 1971) Supported by AEC

(Y-DA-4039; MS71-149; Conf-710434-1) Avail: NTIS

The Y-12 Plant development approach to machining optimization is discussed. Two techniques, automatic error compensation and adaptive control, are being pursued to optimize the product quality of the machining process. Error compensating systems, such as the spindle growth compensator, are discussed. Control equipment, such as self-organizing controllers, are discussed for application to adaptive control.

Author

**N72-11398#** Bendix Corp., Kansas City, Mo.

**FLOW SOLDERING AND SUPPORTING PROCESSES** Final Report

Wm. F. Moyle May 1971 116 p refs

(Contract AT(29-1)-613)

(BDX-613-330) Avail: NTIS

An investigation was conducted to evaluate the application of flow-soldering techniques to the fabrication of printed-wiring board assemblies at Bendix Kansas City. Circuit-board design principles, cleaning methods, solderability tests, and lead-forming techniques were reviewed and present board soldering

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specifications were re-evaluated as supporting activities. Overall results of the project indicate that flow soldering is a suitable process for use on many types of BKC printed circuit-board assemblies, and that use of the method will increase production rates on those assemblies for which it is suited. Author (NSA)

N72-11399# Bendix Corp., Kansas City, Mo.
**CHEMICAL VAPOR DEPOSITION PROCESS EQUIPMENT Progress Report, Period Ending Nov. 1970**
G. J. Hale May 1971 22 p ref
(Contract AT(29-1)-613)
(BDX-613-269) Avail: NTIS

Chemical vapor deposition (CVD) process equipment required for the development and prove-out of CVD processes applicable to the fabrication of tungsten components is described. Progress toward the upgrade of existing equipment, the design of new control equipment, and the specification of new equipment for the general tungsten CVD laboratory is included. Author (NSA)

N72-11400# Bendix Corp., Kansas City, Mo.
**THEORY AND OPERATION OF THE BENDIX MOLD HEATING AND COOLING EQUIPMENT**
R. H. Floersch Jun. 1971 113 p
(Contract AT(29-1)-613)
(BDX-613-369) Avail: NTIS

The theory and operation of mold heating and cooling equipment, used with filled elastomers and rubber and plastic fabrications, are discussed. Included are explanations of the pumping hardware, loop theory, and the loop operation in the manual, automatic, and computer control modes. A mold and fluid response analysis for the cases of open and closed loop is also presented. Author

N72-11401# Bendix Corp., Kansas City, Mo.
**COMPRESSION MOLDING OF LAMINATES Quarterly Report**
R. J. Hishaw May 1971 39 p
(Contract AT(29-1)-613)
(BDX-613-327; FY-70-4) Avail: NTIS

Sequential phases of the process to compression mold a radically-contoured laminate are discussed. Included are topics on layup, mandrel temperature control, molding, cooling, and postcuring. Explanation of problems is aided by photographs where possible. Goals were to produce a high quality, machinable part that exhibits high strength, temperature resistance, and dimensional stability. Comparison of parts produced by varying conditiofs, ease and speed of operation, and production rate analysis provide the basis for the conclusions. Author

N72-11402# Bendix Corp., Kansas City, Mo.
**SOLDER LEVELING OF PRINTED WIRING BOARDS**
W. A. Mulholland Jun. 1971 38 p refs
(Contract AT(29-1)-613)
(BDX-613-443) Avail: NTIS

The results are presented of an investigation to evaluate the solder leveling process for use in the fabrication of printed wiring boards. The thickness of the solder-leveled coating was measured. Two solderability tests were used to determine the solderability of the solder-leveled surface after various storage times. Specially designed printed wiring boards were fabricated that included solderability test samples. Tin-lead coated printed wiring boards were solder leveled and stored for various lengths of time in order to measure solderability after storage. The findings of the study include the following: (1) The thickness of the solder-leveled cbating is nominally 55 micro-inches, regardless of the temperature or pressure of the leveling fluid. A temperature of 430 F and a spray pressure of 60 psig produce the least variation in thickness. (2) The solderability of a solder-leveled surface decreases with time. Printed wiring boards stored up to 5 months were tested. This effect is still being investigated but the decresse in solderability apparently occurs quite rapidly during the first two or three months after solder leveling and then tends to level off within the range of good solderability. Author

N72-11403# Bendix Corp., Kansas City, Mo.
**PERCUSSIVE-ARC VERSUS PULSE-ARC WELDING**
D. L. Hollar May 1971 27 p
(Contract AT(29-1)-613)
(BDX-613-395; PDO-6984100; PDO-6984709) Avail: NTIS

Both percussive-arc and pulse-arc welding have been employed in many applications involving dissimilar metals, principally in joining small-diameter wires to larger terminals. Extensive tests revealed that the most significant difference between the two processes is that percussive-arc welding permits aluminum to be joined to other metals, whereas the pulse-arc process is suitable for joining aluminum wires to aluminum only. The processes have approximately equal capabilities in other areas. Both are suitable for joining many different metals in many metal-to-metal combinations which do not involve brass or other high-zinc-content alloys. Securing the joints before welding is not required with the percussive-arc process, whereas pulse-arc welding requires that the wires or other piece-parts be staked or otherwise secured before they are welded. That feature may make one of the processes more suitable than the other for a specific application. Joints produced by either method meet strength and high-temperature-operation requirements that often preclude the use of soft solder. Author

N72-11404# Sandia Corp., Albuquerque, N.Mex. Safety Engineering Div. 3351.
**RECOMMENDED SAFETY GUIDES, SANDIA LABORATORIES**
William W. Allison Jun. 1971 70 p refs Revised
(SC-M-68-378-Rev-2) Avail: NTIS

Safety guidelines are recommended for reducing the number of fatal accidents, disabling injuries, and high cost. Safer designs of equipment, facilities, and environxent, increased knowledge of possible hazards, control of high risk situations, and safety engineering to protect man when his mind is not on his job are proposed. A study of 82,000 industrial accidents are presented; the results show that in 95 percent of the cases, an unsafe condition existed and that in 93 percent of the cases, the unsafe condition was not corrected after the accident. The use of hazard control guidelines is suggested for design, fabrication, modification, and installation of equipment for improved quality and protection of personnel, facilites, and equipment. J.A.M.

N72-11405# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
**PREPARATION OF SYNTACTIC CARBON FOAM**
S. T. Benton and C. R. Schmitt 16 Jun. 1971 13 p Submitted for publication
(Contract W-7405-eng-26)
(Y-DA-4114; Conf-710612-1) Avail: NTIS

A pressure-molding technique for the fabrication of syntactic carbon foam with high strength and low density characteristics was developed by combining hollow microspheres and carbonaceous binder materials. Hollow microsphere type, size, and wall thickness, along with different binder materials, solvents, and molding pressure were some of the important variables investigated in relation to the compression strength and density characteristic of the syntactic carbon foam. Author

N72-11406# Sundstrand Aviation-Rockford, Ill. Aviation Div.
**BEARING INVESTIGATION: AEC ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM**
T. J. Bland [1971] 150 p refs
(Contract AT(04-3)-651)
(SAN-651-129; AER-619) Avail: NTIS

Continuing research is reported in a program aimed at defining bearing types suitable for use in an organic Rankine cycle space power system of the one to ten kilowatts power range. In the tests conducted, both rolling-contact and hydrodynamic bearings were considered. Descriptions are given of the test hardware and procedures together with the results and final conclusions. D.L.G.

N72-11407# Bendix Corp., Kansas City, Mo.
**SURFACE FRICTION CHARACTERISTICS OF SILICONE RUBBER PADS**
D. L. Hornback Jul. 1971 31 p
(Contract AT(29-1)-613)
(BDX-613-447) Avail: NTIS

A test method was developed to determine variations in surface friction characteristics of silicone rubber pads. Test pads were compressed between parallel steel plates that had been flat ground to a surface finish of approximately 32 microinches. A shear force directed parallel to the surface under compression was applied to the steel plates at a known rate. The magnitude of the shear force as a function of plate movement at constant rate leads to the following conclusions about the frictional resistance force, F, related to plate movement at the test pad surface: (1) F increases with compressive force, (2) F increases to a peak (static) value before decreasing to a lower (dynamic) value that remains fairly constant with continued plate movement, (3) F is not affected by the rate of movement of the plates for low rates, and (4) F does not vary significantly with vendor material lots. Author (NSA)

N72-11408# Bendix Corp., Kansas City, Mo.
**REQUIREMENTS FOR REFLOW SOLDERING OF INTEGRATED CIRCUIT FLATPACKS Final Report**
B. T. Lampe Jul. 1971 61 p refs
(Contract AT(29-1)-613)
(BDX-613-187; PDO-6984374) Avail: NTIS

The requirements for producing strong solder connections by reflow soldering are identified and inspection standards are developed. Evaluated for their effects on joint strength are the tin-lead plating thickness on the printed wiring board, bend angle of the lead, tin-lead coating on the lead, and lead-to-path alignment. The application of solder flux to the conductor path, the value of heat sinks for tinning and soldering, the fusing of printed wiring boards, and the feasibility of multilead soldering are also discussed. The methods described and the criteria given apply specifically to the reflow soldering of integrated circuit flatpacks. Author (NSA)

N72-11409# Royal Swedish Academy of Engineering Sciences, Stockholm.
**ON OPTIMUM DESIGN OF HYDRODYNAMIC LIP SEALS**
Bert Andersson (Lund Tech. Univ.) 1970 70 p refs *Its* Acta Polytech. Scand., Mech. Eng. Ser. 56
(PB-20042; APS-ME-56) Avail: NTIS CSCL 11A

The optimization is considered of hydrodynamic lip seals which are constructed so that the liquid that passes the sealing lip is brought back again by the seal itself. Seals for both unidirectional and bidirectional rotation are studied. The shaft is assumed to be ideally circular and its surface is assumed to be perfectly smooth. Futhermore the shaft is assumed to run without any eccentricity. The liquid to be sealed is assumed to be Newtonian and incompressible and the viscosity variations within the film are neglected. Subatmospheric pressures are also neglected. The aim of the work is to determine the optimum geometry of the seal. This is done numerically and the result is verified by experiments. Author (GRA)

N72-11410# Lockheed Missiles and Space Co., Sunnyvale, Calif. Ground Vehicle Systems.
**FLYWHEEL FEASIBILITY STUDY AND DEMONSTRATION Final Report**
R. R. Gilbert, J. R. Harvey, G. E. Hever, and L. J. Lawson 30 Apr. 1971 165 p refs
(Contract EHS-70-104)
(PB-200143; LMSC-D0079115) Avail: NTIS CSCL 13I

The feasibility of application of flywheel only and flywheel hybrid propulsion systems to four classes of vehicles is studied. Author (GRA)

N72-11411# Lockheed-Georgia Co., Marietta.
**MANUFACTURING METHODS DEVELOPMENT OF SPOT-WELD ADHESIVE BONDED JOINING FOR TITANIUM Final Technical Report, 5 Nov. 1970 - 28 Feb. 1971**
Dallas Fields Wright-Patterson AFB, Ohio AFML Jun. 1971 107 p
(Contract F33615-71-C-1099; AF Proj. 827-9)
(AD-725039; AFML-TR-71-93) Avail: NTIS CSCL 13/8

Work during the program established basic parameters for joining titanium alloy using the resistance spot-weld-adhesive bonding (weldbonding) process. Design of test parameters for evaluation of static strength of weldbonded joints in titanium alloy required that first consideration be given to the probable use of the alloy developed process. Since a high percentage of titanium used in joints of military aircraft would involve areas either exposed to high stress and/or elevated temperatures, strength at elevated temperatures was given prime consideration. Test results analysis showed that weldbond joints were superior in strength at room temperature as compared to all other joints tested. Weldbond joints and/or spot-weld joints were superior in strength in all categories from room temperature to 400F as compared to other joints tested. Mechanical fasteners plus adhesive showed the third highest strength as compared to other joints. Structural adhesive bond joints were generally inferior in strength to all other joints from room temperature through 400F. Author (GRA)

N72-11412# School of Aerospace Medicine, Brooks AFB, Tex.
**BASIC PRINCIPLES AND METHODS OF THE THEORY OF RELIABILITY [OCNOVNYE PRINTSIPY I METODY TEIORII NADEZHNOSTI]**
I. A. Ushakov 1971 20 p Transl. into ENGLISH from the Russian
(AD-725323; SAM-TT-R-1055-0571) Avail: NTIS CSCL 14/4

Contents: Basic concepts; Abstract description of the process of functioning of a device; Primary indicators of reliability; Unity of reliability indicators; The concept of operative effectiveness; Concept of reliability at a new qualitative level; The problem of isomorphism of mathematical models with actual objects in the theory of reliability; Means for increasing reliability and operative effectiveness; The development of methods for analysis and synthesis of the reliability of complex systems; The role of the mathematical theory of reliability; Problems of reliability and bionics. GRA

N72-11694*# General Electric Co., Cincinnati, Ohio. Material and Process Technology Labs.
**LUBRICANT AND FUEL INTERACTIONS IN ADVANCED AIRCRAFT GAS TURBINES**
E. N. Bamberger, D. B. Hester, and M. W. Shayeson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs Sponsored in part by NASA, AFAPL, and FAA (See N72-11668 02-27)
(NASA-CR-122842) Avail: NTIS CSCL 11H

N72-11695# Esso Development Co., Ltd., Abingdon (England). Research Centre.
**STABILITY OF SYNTHETIC AVIATION GAS TURBINE LUBRICANTS AT HIGH TEMPERATURES**
R. Robson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11697# Rolls-Royce, Ltd., Bristol (England). Engine Div.
**LUBRICANT EXPERIENCE AND DUTIES IN A CIVIL SUPERSONIC GAS TURBINE ENGINE**
E. W. Doherty *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p ref (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

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N72-11698# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.
**EARLY STAGE DETECTION OF OIL CHANGES IN AIRCRAFT ENGINES**
E. Jantzen *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11699# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**THERMAL STABILITY OF A TRI-METHYL-PROPANE ESTER BASED LUBRICATING OIL [CHAMP D'APPLICATIONS D'UNE HUILE BASEE SUR UN ESTER DU TRIMETHYLOL-PROPANE]**
F. Reynaud *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 22 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
**SOLID LUBRICATION FOR AERO PROPULSION SYSTEMS**
M. R. Chasman *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11701# BP Benzin und Petroleum AG, Munich (West Germany).
**SYNTHETIC LUBRICANTS FOR SUPERSONIC AIRCRAFT**
H.-D. Dorn *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 6 p (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11035# Pacific Airmotive Corp., Burbank, Calif.
**PACIFIC AIRMOTIVE CORPORATION ACCESSORY RELIABILITY PROGRAM (PACAR)**
David Snyder *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

## 16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-11413 Purdue Univ., Lafayette, Ind.
**PASSIVE FEEDBACK CONTROL IN A RUBY LASER Ph.D. Thesis**
John Clyde Stover 1970 70 p
Avail: Univ. Microfilms Order No. 70-18741

The feasibility of pulse stretching in a Q switched laser is investigated. Control of pulses with half widths of less than 300 nanoseconds is given special attention. It is felt that inserting two loss systems are reported. One is a loss due to the frequency discrimination of the laser linewidth. Laser power is shifted in frequency by stimulated Rayleigh wing scattering to higher loss sections of the linewidth. The amount of shift and the amount of power shifted are power dependent. The second system involves discrimination on the basis of polarization. The induced rotation of the polarization ellipse associated with self-focusing is used. Experimental results show power limiting and pulse stretching both to be as high as ten to one. The Rayleigh effect produces control at lower power levels than the induced polarization rotation system. Rate equations are developed to include the nonlinear loss terms and the saturable absorber Q-switch terms. Computer solution of a simplified model suggested by these equations indicates pulse shape changes similar to those observed experimentally. Dissert. Abstr.

N72-11414*# Sylvania Electronic Systems-West, Mountain View, Calif.
**SPACE QUALIFIED Nd:YAG LASER (PHASE 1 - DESIGN) Final Engineering Report, 1 Jul. 1969 - 1 Jun. 1970**
J. D. Foster and R. F. Kirk Washington NASA Oct. 1971 187 p refs
(Contract NAS12-2160)
(NASA-CR-1771) Avail: NTIS CSCL 20E

Results of a design study and preliminary design of a space qualified Nd:YAG laser are presented. A theoretical model of the laser was developed to allow the evaluation of the effects of various parameters on its performance. Various pump lamps were evaluated and sum pumping was considered. Cooling requirements were examined and cooling methods such as radiation, cryogenic and conductive were analysed. Power outputs and efficiences of various configurations and the pump and laser lifetime are discussed. Also considered were modulation and modulating methods. Author

N72-11415*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**HOLOGRAPHIC STRESS ANALYZER FOR SOLDER JOINTS Patent Application**
John R. Williams, inventor (to NASA) Filed 14 May 1971 13 p
(NASA-Case-MFS-20687; US-Patent-Appl-SN-143509) Avail: NTIS CSCL 20E

A method and apparatus for holographic nondestructive testing are described. The output beam from a laser is split into a reference beam and a signal beam. The reference beam is directed to a photographic plate without being modulated by the test object. The singal beam is directed into a metallograph which illustrates the test object and produces the image of it at the photographic plate. The reference and signal beams incident on the photographic plate produce a holograph of the test object. NASA

N72-11416# Sandia Corp., Albuquerque, N.Mex. Photometrics Div.
**PHOTOGRAPHIC RESPONSE OF CERTAIN FILMS TO Q-SWITCHED RUBY LASER ENERGY**
Clarence E. Robertson Jul. 1971 27 p refs Sponsored by AEC
(SC-DR-710293) Avail: NTIS

Typical photographic films are calibrated in terms of white light exposures at some particular color temperature. D-log, E-curves generated by ruby laser exposures in the 40 nanosecond exposure range are provided; Eastman Kodak RAR 2485, 2496, 2479, and H.S. IR are among the films examined. Laser exposures, narrowband red sensitometric exposures (30 A wide at 6900 A), and white light sensitometric exposures are compared for speed differences and changes in film character.
Author (NSA)

N72-11417# Airborne Instruments Lab., Deer Park, N.Y.
**RESEARCH ON IMAGING PROPERTIES OF OPTICAL PARAMETRIC UPCONVERTER Final Report**
W. Chiou and F. Pace Jul. 1971 170 p refs
(Contract N00014-70-C-0161; ARPA Order 306)
(AD-727131; AIL-8585-1) Avail: NTIS CSCL 20/6

The imaging properties of parametric upconversion have been investigated analytically and experimentally for the case of monochromatic object waves, and photographs of upconverted 10.6 micrometers images obtained. Using geometric optics an expression was derived relating the locations of the object, the pump and the upconverted image. The effect of higher order factors such as crystal birefringence, phase mismatch, and pump wave divergence were considered qualitatively. The analysis was then extended by applying the techniques of physical optics. Using Fourier transformer formalism an expression was derived relating the angular spectrum of the sum-frequency field with that of the object and pump fields. Two cases were examined in

detail, one using a plane wave pump and the other with a Gaussian distributed pump beam. Author (GRA)

N72-11418# Naval Research Lab., Washington, D.C.
**PROPAGATION OF HIGH-ENERGY 10.6-MICRON LASER BEAMS THROUGH THE ATMOSPHERE Interim Report**
Alfred H. Aitken, John H. Hayes, and Peter B. Ulrich 28 May 1971 46 p refs
(Ord Proj. 0832-129-173-1)
(AD-725111; NRL-7293) Avail: NTIS CSCL 20/5

The purpose of the present investigation is the determination of the properties of an intense 10.6-micron laser beam propagating through the open atmosphere in the presence of wind or slewing, or both. It is shown that the Maxwell equations can, in this problem, be reduced to the study of the scalar wave equation with a varying index of refraction. The index of refraction is related to the atmospheric density; therefore, the density changes in the air due to beam absorption are related to the absorption coefficient of the air and to the intensity of the beam, using the linearized hydrodynamic equations. A detailed discussion of the mechanisms of photon absorption by the cofstituents of the air is presented. The resultant equation for the scalar wave is a nonlinear partial differential integral equation which is solved numerically. The algorithm used for the computer code is discussed, together with criteria that have been determined to be useful in assessing the accuracy and reliability of the numerical results. The solutions of several different problems are presented and discussed. In particular, it is found that (a) beam quality is degraded for water vapor pressures at or near sea level, and (b) beam slewing reduces the detrimental effect of water vapor. Author (GRA)

N72-11419# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Electrophysics.
**RESEARCH DIRECTED TOWARDS THEORETICAL METHODS FOR DEALING WITH QUANTUM-OPTIMAL DEVICES Final Report, 1 Jan. 1968 - 31 Dec. 1970**
Stephen R. Barone, Maurice C. Newstein, and Nicholas Solimene Feb. 1971 126 p refs
(Contract F19628-68-C-0177; AF-5634 Proj.)
(AD-725775; PIBEP-71-087; AFCRL-71-0138) Avail: NTIS CSCL 20/5

The report presents results of research directed toward the development of theoretical methods for dealing with quantum optical devices. The main areas of progress were in: (1) determining the fluctuation and response characteristics of several pertinent physical systems driven by resonant fields and (2) developing analytic descriptions of the processes involved in the generation and propagation of ultra-short pulses.
Author (GRA

# 17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N72-11420 National Lending Library for Science and Technology, Boston Spa (England).
**INTERNAL MECHANICAL STRESSES IN THIN VAPOUR DEPOSITED ALLOYED FILMS**
D. Sterneck 22 Sep. 1971 6 p Transl. into ENGLISH from Nachrichtentechnik, Elektronik (East Germany), v. 20, no. 12, 1970 p 454-456
(NLL-PORS-Trans-2781-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Thin films produced on a carrier by vapor condensation in a high vacuum are frequently subjected to considerable mechanical stresses. Since the reliability and physical properties of a contact point in microelectronics depends to a large extent on the mechanical stresses at the contact point, the systematics, measurement, dependence and occurrence of internal mechanical stresses in thin vapor-deposited films are investigated. Results are inconclusive. One interesting factor emerges, however, namely that stresses generally build up in the metals during condensation so that processes involved lead to a contraction of the film, its density increases and island structures are formed.
Author

N72-11421 National Lending Library for Science and Technology, Boston Spa (England).
**EFFECT OF THE COMPOSITION AND CONDITIONS OF HEAT TREATMENT ON THE ADSORBABILITY OF Al2O3-TiO2 [VLIYANIE SOSTAVA I USLOVII TERMICHESKOI OBRABOTKI NA ADSORBTSIONNUYU AKTIVNOST A1203-TI02]**
N. F. Ermolenko and G. G. Korunnaya Aug. 1971 9 p refs Transl. into ENGLISH from Vestsi Akad. Navuk. BSSR, Ser. Khim. Navuk (USSR), no. 4, 1970 p 14-19
(NLL-RTS-6619) Avail: Natl. Lending Library, Boston Spa, Engl.: £ 0.90; 3 NLL photocopy coupons

The adsorption isotherms for water vapor on a pure preparation of TiO2 (IV) and a preparation containing 71% TiO2, calcined at a high temperature, approach a concave form. A decrease in the value of the energy constant C as the calcination temperature increases has been established for the TiO2 preparation (IV) via the B.E.T. relation. Partially irreversible hysteresis has been detected during the adsorption of water vapor on preparations I and II, calcined at 600 C. The structure and adsorption properties of a Al2O3-TiO2 preparation containing app. 28% TiO2 are based on the Al2O3, and containing app. 71% TiO2 - on the latter. Author

N72-11422 National Lending Library for Science and Technology, Boston Spa (England).
**THE MECHANISM OF SUPERPLASTICITY IN NICKEL-CHROMIUM EUTECTRIC ALLOYS [O MEKHANIZME SVERKHPLASTICHNOSTI NIKELKHROMISTOGO SPLAVA EVTICHESKOGO SOSTAVA]**
V. G. Osipov, A. S. Tikhonov, and M. Kh. Shorshorov Sep. 1971 8 p refs Transl. into ENGLISH from Fiz. Khim. Obrab. Mater. (USSR), no. 6, 1970 p 76-81
(NLL-RTS-6683) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.80; 3 NLL photocopy coupons

Experimental studies of the superplasticity effect in Ni + 49%Cr alloys, near in chemical composition to eutectic concentration, are reported. Possible causes of this effect are examined. From considerations of the rate of creep of vacancies and the contribution vacancies make to the growth of cavities during strain of the metal, the suggestion is advanced that one of the possible mechanisms controlling the superplasticity effect in an alloy of Ni + 49%Cr is the diffusion creep of vacancies.
Author

N72-11423 National Lending Library for Science and Technology, Boston Spa (England).
**TECHNOLOGICAL POSSIBILITIES AND DUCTILITY OF METALS WHEN HIGH SPEED FORGING IS EMPLOYED [TEKHNOLOGICHESKIE VOZMOZHNOSTI I PLASTNICHNOST METALLOV V USLOVIYAKH VYSOKOSKOROSTNOI SHTAMPOVKI]**
Yu. P. Sogrishin, N. F. Kobyakovskii, A. V. Popov, and V. Ya. Morov Aug. 1971 21 p refs Transl. into ENGLISH from Eksperim. Inst. Kuznechno-Pressovogo Mash. (Moscow), no. 21, 1969 p 9-26
(NLL-RTS-6446) Avail: Natl. Lending Library, Boston Spa, Engl.: £2.10; 7 NLL photocopy coupons

Graphs for the relationships of specific forces and deformation energies were used for calculating the force, energy and dimensional parameters of a range of high-speed hammers intended for mass production. Author

THE UNIVERSITY OF MICHIGAN LIBRARIES

**N72-11424** National Lending Library for Science and Technology, Boston Spa (England).
**HYDROGEN ABSORBER TO AVOID HYDROGEN EMBRITTLEMENT IN ZIRCONIUM ALLOYS**
W. Spalthoff and H. Wilhelm 19 Aug. 1971 4 p Transl. into ENGLISH from German report Presented at the 1969 Reactor Symp. of the Ger. Atom Forum, Frankfurt am Main, 15-19 Aug. 1969
(NLL-Windscale-Tr-467-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The advantages of yttrium as a hydrogen absorber in zirconium alloy fuel cans and pressure tubes used in water cooled reactors are discussed. Diffusion experiments were carried out using small zirconium plates, which initially contained a few hundred ppm hydrogen, combined with low hydrogen yttrium. These showed that the hydrogen migrated into the yttrium. Further experiments confirmed that suitably incorporated yttrium can keep zirconium alloy parts free of hydrogen. J.G.M.

**N72-11425** National Lending Library for Science and Technology, Boston Spa (England).
**WROUGHT ZINC-COPPER TITANIUM ALLOYS. PART 1: ALLOY STRUCTURE. PART 2: MECHANICAL PROPERTIES OF THE ALLOYS**
Z. Wendorff and W. Piotrowski 19 Aug. 1971 29 p refs Transl. into ENGLISH from Rudy Metale Niezelazne (Katowice), v. 11, no. 3, Mar. 1966 p 131-134 and Rudy Metale Niezelazne (Katowice), v. 11, no. 4, Apr. 1966 p 198-203 In ENGLISH and POLISH
(NLL-Trans-71/309-(9023.6)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The effect of titanium on the structure and mechanical properties of zinc-copper alloys has been investigated. The optimum mechanical properties are exhibited by alloys containing 0.5-2.0% copper with a constant titanium content in the range of 0.1-0.15%. After hot rolling the alloys studied exhibit mechanical properties similar to those of brasses in the annealed state and are suitable for use in deep drawing operations without the need for an intermediate heat treatment. Author

**N72-11426** National Lending Library for Science and Technology, Boston Spa (England).
**STEELS FOR TEMPERATURE UNDER 400 C**
W. Schoch 22 Sep. 1971 25 p refs Transl. into ENGLISH from the German Report
(NLL-CE-Trans-5684-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupon

The grades of steel used in Germany at temperatures of 400 C and less for applications in the chemical industry and in power generation are discussed. The characteristics of ferritic/pearlitic fine grained steels are described. Recommendations for welding both types of steel are presented. The behavior of steels under the corrosion effects of high pressure boilers is analyzed. Author

**N72-11427#** Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
**GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS IN BISMUTH-ANTIMONY ALLOYS AT LOW TEMPERATURES Ph.D. Thesis [GALVANOMAGNETISCHE UND THERMOMAGNETISCHE EFFEKTE Bi-Sb-LEGIERUNGEN BEI TIEFEN TEMPERATUREN]**
Burkhard Fay 1970 102 p refs In GERMAN
Avail: NTIS

Low temperature electrical transport properties of pure and doped bismuth antimony single crystals are reported. The combination bi88Sb12 possesses the largest energy band gap, and exhibits n-conductivity and high thermoelectric effectiveness at 100 k under transverse magnetic field. Additive Sn, Ga, and Cd elements produce thermodynamic inversions at low temperatures. Anisotropy of the transverse magnetic resistance change in doped and pure bi88Sb12 probes is attributed to changes in partial thermal forces and in partial specific conductivity in the magnetic field. Transl. by G.G.

**N72-11428*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**COMPRESSIVE BEHAVIOR OF TITANIUM ALLOY SKIN-STIFFENER SPECIMENS SELECTIVELY REINFORCED WITH BORON-ALUMINUM COMPOSITE**
Harvey W. Herring, Robert L. Carri, and Ross C. Webster Washington Nov. 1971 27 p refs
(NASA-TN-D-6548; L-7938) Avail: NTIS CSCL 20K

A method of selectively reinforcing a conventional titanium airframe structure with unidirectional boron-aluminum composite attached by brazing was successfully demonstrated in compression tests of short skin-stiffener specimens. In a comparison with all-titanium specimens, improvements in structural performance recorded for the composite-reinforced specimens exceeded 25 percent on an equivalent-weight basis over the range from room temperature to 700 K (800 F) in terms of both initial buckling and maximum strengths. Performance at room temperature was not affected by prior exposure at 588 K (600 F) for 1000 hours in air or by 400 thermal cycles between 219 K and 588 K (-65 F and 600 F). The experimental results were generally predictable from existing analytical procedures. No evidence of failure was observed in the braze between the boron-aluminum composite and the titanium alloy. Author

**N72-11429#** Grumman Aerospace Corp., Bethpage, N.Y. Materials and Structural Mechanics Section.
**CALORIMETRIC STUDY OF PRECIPITATION IN A COMMERCIAL (7075) ALUMINUM ALLOY**
P. Adler, G. Geschwind, and R. Delasi Oct. 1971 22 p refs Presented at 3d Intern. Conf. on Thermal Analysis, Davos, Switzerland, 23-28 Aug. 1971
(RM-518J) Avail: NTIS

Specific heat, hardness, and transmission electron microscopy were used to evaluate the solid state reactions related to solution and aging heat treatments and their effect on mechanical strengthening. Calorimetric studies indicate three endothermic and two exothermic reactions on heating from 25 C to 470 C. The endotherms are due to reversion of GP zones, dissolution of intermediate MgZn2 type precipitate, and dissolution of the stable MgZn2 type precipitate. Hardness increased with higher heat input during solution treatment and was found to be a function of GP zone concentration. The results suggest that maximum strength is based on the partition of excess solute between internal surface defects and GP zones. Precipitation at these defects depletes matrix solute and reduces attainable strength. Author

**N72-11430*#** Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
**THE ROLE OF HYDROGEN IN HOT-SALT STRESS CORROSION CRACKING OF TITANIUM-ALUMINUM ALLOYS**
R. S. Ondrejcin Washington NASA Nov. 1971 21 p refs
(NASA Order R-41-003-001; Contract AT(07-2)-1)
(NASA-CR-1915; DP(NASA)-1253) Avail: NTIS CSCL 11F

Additional support is presented for the previously proposed role of hydrogen as an embrittling agent in hot-salt stress corrosion cracking of titanium-aluminum alloys. The main source of hydrogen formed during the reactions of titanium alloys with hot salt was identified as water associated with the salt. Hydrogen is produced by the reaction of an intermediate (hydrogen halide) with the alloy rather than from metal-water reactions. The fracture mode of precracked tensile specimens was ductile when the specimens were tested in air, and brittle when tests were made in high-pressure hydrogen. Stressed titanium-aluminum alloys also were cracked by bombardment with hydrogen ions produced in a proton accelerator. The approximate concentrations of the hydrogen ions in the alloys were calculated. Author

**N72-11431*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EXPLORATORY STUDY OF FRICTION WELDS IN UDIMET**

**700 AND TD-NICKEL BAR**
Thomas J. Moore Washington Nov. 1971 19 p refs
(NASA-TM-X-2411; E-6425) Avail: NTIS CSCL 11F

Friction welded butt joints were made in both Udimet 700 and TD-Nickel bar. Also, dissimilar metal friction welds were made between these materials. Friction welding of Udimet 700 shows great promise because the welds were found to be as strong as the parent metal in stress rupture and tensile tests at 760 and 980 C. The weld line was not detectable metallographically in the heat treated condition. Friction welding for TD-Nickel, however, holds little if any promise. TD-Nickel friction weldments could support only 9 percent as much stress as the base metal for a 10-hour stress-rupture life at 1090 C. Dissimilar Udimet 700/TD-Nickel friction welds could sustain only 15 percent as much stress as the TD-Nickel parent metal for a 10-hour rupture life at 930 C. Author

**N72-11432*#** Vought Missiles and Space Co., Dallas, Tex.
**EVALUATION OF METAL MATRIX COMPOSITES**
K. P. O'Kelly 31 Aug. 1971 79 p refs
(Contract NAS9-8260)
(NASA-CR-115221; Rept-00-1471) Avail: NTIS CSCL 11F

The results of an evaluation of candidate metal-matrix composite materials for shuttle space radiators mounted to external structure are presented. The evaluation was specifically applicable to considerations of the manufacturing and properties of a potential space radiator. Two candidates, boron/aluminum and graphite/aluminum were obtained or made in various forms and tested in sufficient depth to allow selection of one of the two for future scale-up programs. The effort accomplished on this program verified that aluminum reinforced with boron was within the state-of-the-art in industry and possessed properties usable in the external skin areas available for shuttle radiators where re-entry temperatures will not exceed 800 F. It further demonstrated that graphite/aluminum has an apparently attractive future for space applications but requires extension development prior to scale-up. Author

**N72-11433*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**APPARATUS FOR PRODUCING METAL POWDERS Patent Application**
Alan Arias, inventor (to NASA) Filed 25 Jun. 1971 14 p
(NASA-Case-XLE-06461-2; US-Patent-Appl-SN-156778) Avail: NTIS CSCL 11F

The invention described produces metal powders of controlled particle size by reducing oxides with the vapor of a reactive metal in a vacuum. The particle size of the resulting powder is determined by the temperature at which the reactions are permitted to take place. The higher the reaction temperature, the larger the particle size of the metal powder. Also, the longer the powder is held at temperature, the larger the particle size. If the reaction is permitted to become self-sustaining because the reactions are exothermic, close control of particle size is no longer feasible. NASA

**N72-11434#** Bettis Atomic Power Lab., Pittsburgh, Pa.
**PLANE-STRESS YIELD LOCI FOR ZIRCOLAY-4 TUBING ESTIMATED FROM KNOOP HARDNESS (LWBR DEVELOPMENT PROGRAM)**
S. J. Goldberg and C. C. Busby May 1971 33 p refs
(Contract AT(11-1)-Gen-14)
(WAPD-TM-975) Avail: NTIS

The plane stress yield loci of five Zircaloy-4 tubing lots, varying in both texture and heat treatment condition, were determined from Knoop microhardness measurements made in the two principal directions of each of the three orthogonal surface. The Knoop data were normalized to two differently determined theoretical first-quadrant loci (one based on the pressure-burst yield stress, and the other based on the approximation P = 1.7R, where R and P are the longitudinal and transverse contractile strain ratios). For these materials in which R varied from 0.76 to 2.8, it was concluded that the Knoop hardness flow surface for tubing of comparable heat treatment condition was sensitive to a change in texture (increase in R value) and indicated to expected texture hardening under combined tension or compression loading. For a given tubing, however, it could not be established that the yield behavior was consistently different under compression (third quadrant) and tension (first quadrant) loading. Author (NSA)

**N72-11435#** Westinghouse Electric Corp., Pittsburgh, Pa.
**DYNAMIC FRACTURE TOUGHNESS PROPERTIES OF HEAVY SECTION A533 GRADE B CLASS 1 STEEL PLATE**
W. O. Shabbits Dec. 1970 71 p refs Prepared for ORNL
(Contract ORNL-3078)
(WCAP-7623; HSSTP-TR-13) Avail: NTIS

Loading rate effects on the fracture toughness K sub Ic properties of ASTM Grade B Class 1 steel were studied using compact tension specimens 1 to 8 inches thick. Dynamic fracture toughness data (K sub Id) at rates approaching one millisecond to fracture, or K equal to 100,000 Ksi square root of inch/second, were generated for temperatures up to 150 F. The temperature dependence of K sub Id was studied at given K and noteable reductions in toughness were found at ambient temperatures. These results indicate a temperature dependence of (K sub Id) dynamic toughness similar to the previously determined K sub Ic behavior with a shift toward higher temperature. A study of the effects of varying the load rate at a given temperature indicated a gradually decreasing toughness between loading rates (K) of 2.5 and 100,000 Ksi square root of inch/second. Also, the details of the fixturing, instrumentation, experimental techniques, and interpretation procedure are included. The experimental limitations and the significance of the results are discussed. Author (NSA)

**N72-11436#** Bendix Corp., Kansas City, Mo.
**FLATPACK INSTALLATION BY SINGLE-PROBE REFLOW SOLDERING Final Report**
D. W. Bowlen May 1971 55 p
(Contract AT(29-1)-613)
(BDX-613-328) Avail: NTIS

An investigation of several reflow-soldering techniques revealed that use of a single heated probe is superior to the other methods evaluated, including the parallel-probe resistance-soldering method which was in production use at the beginning of this work. The most notable improvements resulting from adoption of the single-probe soldering process were increased production rates, less necessity for reworking the boards to correct for misalignment and imperfect electrical connections, marked improvements in the appearance and quality of the board assemblies, and significant savings in labor and expensive flatpacks. Other supporting processes that were improved during this development included lead forming, lead tinning, and pc-board cleaning processes required to maintain solderability.
Author (NSA)

**N72-11437#** California Inst. of Tech., Pasadena. Keck (W. M.) Lab. of Engineering Materials.
**ELECTRICAL RESISTIVITY AND MAGNETIC SUSCEPTIBILITIES OF AMORPHOUS Cr-Ni-Pt-P ALLOYS**
Ashok K. Sinha Jun. 1971 8 p refs
(Contract AT(04-3)-822)
(CALT-822-31; Rept-26) Avail: NTIS

Alloys having compositions represented by (Cr(x)Ni(0.30-x)-Pt(0.70))0.75P(0.25) where x = 0.015, 0.03, 0.045 and 0.06, were prepared by solid-phase sintering and subsequent melting of powder compacts. The amorphous phase was obtained by rapid quenching of the melt using the Piston and Anvil technique. The amorphous structure of the resulting foils was checked through X-ray diffraction. Strips were cut out of these foils for electrical resistivity measurements, which were made using the standard 4-probe method. The material from these strips was used for magnetic measurements with a null-coil pendulum magnetometer under fields ranging from 1 to 8.5 KOe. All measurements were made down to 4.2 K. Author

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N72-11438# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
**ROLE OF DESIGN IN CORROSION PREVENTION**
Lyle D. Perrigo 1971 33 p refs Presented at the 5th Ann. Western States Corrosion Seminar, San Dimas, Calif., 4-6 May 1971
(Contract AT(45-1)-1830)
(BNWL-SA-3817; Conf-710504-2) Avail: NTIS

The generalized rules used to reduce corrosion in system designs, structures and equipment are presented. Also included are examples of good and bad design practice and remedies for bad design and different system needs. E.H.W.

N72-11439# Vanderbilt Univ., Nashville, Tenn.
**CORRELATIONS BETWEEN TENSILE PROPERTIES AND DISLOCATION INTERACTIONS IN THE Cu-22.5-Pt L1 SUB 2 SUPERLATTICE Ph.D. Thesis**
Raymond Allen Buchanan Jan. 1971 125 p refs
(Contract AT(40-1)-3091)
(ORO-3091-19) Avail: NTIS

The detailed dislocation interactions in the L1 sub 2 superlattice as they are affected by varying states of order are reported. The system chosen for the study was Cu-22.5Pt alloy whose tensile properties were determined at room temperature as a function of the degree of long range order (LRO) concurrently with X-ray line broadening and lattice parameter analyses of the deformation-produced substructure. The X-ray analyses showed the true particle sizes to be very large and the stacking fault probabilities to be very low. These results indicated relatively low dislocation densities. During the tensile deformation, inhomogeneous yielding was observed wherein the Luders strain was found to increase with increasing degree of LRO. Also at yielding, the lower yield stress variations with degree of LRO indicated that a maximum would occur in the range $0 < S < 0.62$. The strain hardening rate was found to be extremely dependent on the degree of LRO. In each of the ordered samples, the strain hardening rate initially increased, attained a maximum value, and subsequently decreased with increasing tensile strain. In the ordered samples, the strain hardening rate decreased with increasing strain from its initial value. Author

N72-11440# Vanderbilt Univ., Nashville, Tenn. Dept. of Materials Science and Metallurgical Engineering.
**DEFORMATION STUDIES OF SUPERLATTICE STRUCTURES Final Report, 1 Mar. 1963 - 31 Aug. 1970**
James J. Wert and Robert J. Bayuzick 1 Jul. 1971 10 p refs
(Contract AT(40-1)-3091)
(ORO-3091-21) Avail: NTIS

The influence of an ordered structure on mechanical properties was studied in detail. The differences in strain hardening rates associated with ordered alloys, compared to the disordered states, have been found to be dependent upon cross-slip of superdislocations moving on 111 glide planes to /100/ cube planes. In particular, the strain hardening dependence on long range order (LRO) was found to be dependent on the frequency of cross-slip. Since attainment of varying degrees of order was necessary, the time, temperature dependence of the LRO parameter of Cu3Pt was determined by the resistivity method. Significantly, the nature of the disorder to order transformation appears to change as the temperature changes. Complementary to the work on Cu-Pt alloys, the kinetics of antiphase domain growth in beta-brass and Fe3Al were determined, the antiphase domain boundary energies were calculated, and the motions of antiphase boundaries were investigated. Author (NSA)

N72-11441# South Carolina Univ., Columbia.
**POWER METALLURGY COMPACTION Quarterly Progress Report, 1 Mar. - 31 May 1971**
E. G. Schwartz, James B. Hornsby, Riley G. Hammond, Jr., and Tiee-Bor Ni 31 May 1971 6 p
(Contract AT(38-1)-475)
(SRO-475-11) Avail: NTIS

Three methods of reducing die wall friction were studied: vibration, translation, and rotation of the die. Density studies for static and translating compacts were undertaken. Experimental results for a single rotational speed indicate that friction is reduced when the die is rotated. Data are presented in graph form. Author

N72-11442# Oak Ridge National Lab., Tenn. Reactor Div.
**DISCUSSION OF SwRI MODEL PARAMETER TESTS**
G. C. Robinson Jun. 1971 21 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3313) Avail: NTIS

The testing of large, flawed, 6-in.-thick specimens in tension, preferably representative of ordinary tensile specimen testing is considered. The tests are being performed on a special, large, 15,000,000-lb capacity, wide, thin-plate, tensile testing machine. Adapting the machine for the testing of thick plates imposed a nonideal length confinement on the large, thick-plate specimen. Using a specimen with a shorter gage length than was deemed desirable created a distinct possibility that the data obtained in the test region could be biased by restraints from the nearby reinforced grip ends. A model parametric study of the effect of the specimen geometry on failure load was conducted to evaluate the degree of error introduced by this lack of gage length and to insure that the data from the full-scale series would be useful without more extensive investigations of the shape of the specimen, its length-to-width, and width-to-thickness ratios. The model parametric tests have substantiated the validity of the data from the full-scale tests now underway, but have also indicated that testing of specimens with larger width-to-thickness ratios will give nonrepresentative data. Author (NSA)

N72-11443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATION OF ACTUAL FLOW STRESSES DURING TENSION WITH SUPERPLASTICITY**
R. K. Aubakirova and A. A. Presnyakov 19 Feb. 1971 12 p refs Transl. into ENGLISH from Akademiya Nauk, SSSR, no. 6, 1969 p 141-145
(FTD-60202 Proj.)
(AD-725007; FTD-HT-23-58-71) Avail: NTIS CSCL 20/12

The curves of actual flow stresses during tension of conventional metals at high temperatures and of superplastic eutectoid Al-Zn were investigated, indicating a sharp difference between them during the course of the flow stresses. Peculiar to pure metals is strengthening during hot deformation, which finishes up by a sudden fracture of the samples. Three deformation periods are observed on the curves showing the actual flow stresses. GRA

N72-11444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SELECTION OF MATERIALS FOR PARTS OPERATING UNDER BEARING CONTACT AND EROSION-CORROSION WEAR CONDITIONS**
B. A. Kirievskii, V. I. Tikhonovich, S. S. Zatulovski, and G. N. Gordon 13 Jan. 1971 14 p refs Transl. into ENGLISH from Litye Iznosostoikie Materialy, Kiev, 1969 p 17-24
(AF Proj. 7343)
(AD-725011; FTD-MT-24-282-70) Avail: NTIS CSCL 11/6

The effects of the simultaneous actions of erosion and friction on the wear of 4 kinds of cast-iron containing Cr 12.40-14.05 and C 1.15-1.71 wt percent were studied. Two of these cast irons were inoculated. The friction deformation of some of the cast irons had a large accelerating effect on the corrosion resistance. For instance, the corrosion rate of 2 cast irons during friction in a condensate medium without preliminary friction deformation, was 0.0336 and 0.0292 mm/year, respectively, while after deformation, the corrosion rate at similar conditions 0.056 and 0.0196 mm/year, respectively. This difference is assumed to be the result of considerable changes in the structure of the surface layer. During friction deformation as the result of increased temperature, phase and allotropic

transformations took place to the depth of 45-60 mu, with the formation of austenite. Although austenite is more corrosion resistant than ferrite, volume changes during the transformation resulted in the formation of fissures with resulting acceleration of corrosion disintegration. Cr, Mo, and W diffuse inward from the surface layer during the friction deformation and this also accelerates the erosion rate. For proper evaluation of the wear, the materials should be tested by exposure. Author (GRA)

**N72-11445#** British Iron and Steel Research Association, London (England).
**DETERMINATION OF TRACE AMOUNTS OF BISMUTH IN FERROUS ALLOYS BY SOLVENT EXTRACTION FOLLOWED BY ATOMIC ABSORPTION SPECTROPHOTOMETRY**
J. B. Headridge and J. M. Richardson Jun. 1971 8 p refs Supersedes MG/D/436/70
(PB-201662; MG/D/421/71; MG/D/436/70) Avail: NTIS CSCL 11F

A method is described for the atomic-absorption spectrophotometric determination of 2 to 130 micro gram/gram of bismuth in cast irons and stainless steels. From an aqueous solution of an alloy, which was 2.3 M in hydrochloric acid, 0.09 M in ascorbic acid and 0.2 M in potassium iodide, the bismuth was extracted quantitatively into 4-methylpentau-2-one on one shaking while the base elements were left in the aqueous phase. After concentration, the organic phase was nebulized into an air-acetylene flame of a Unicam SP 90 atomic-absorption spectrophotometer. The results of applying the solvent extraction procedure to twenty-seven other elements of interest to the steelmaker are also reported. Author (GRA)

**N72-11446#** National Bureau of Standards, Washington, D.C.
**THE ROLE OF PASSIVE FILM GROWTH KINETICS AND PROPERTIES IN STRESS CORROSION SUSCEPTIBILITY**
Technical Summary Report, 1 Mar. 1970 - 28 Feb. 1971
Jerome Ambrose Kruger, John R. Ambrose, and Edward Escalante 13 May 1971 67 p refs
(Contract NAonr-18-69; NBS Proj. 3120448; NR Proj. 036-082)
(AD-725166; NBS-10594; TSR-2) Avail: NTIS CSCL 11/6

A new technique has been developed for studying the rate of repassivation of a stressed metal surface exposed by film rupture. This technique, which removes the film on a metal by abrasion and then follows film regrowth and metal dissolution by transient ellipsometry and current transients, was applied to low carbon steel in a nitrate solution where it stress cracks and a nitrite where it does not. The rate of repassivation was greater in the non-susceptible solution while the ratio of current going into film formation to that producing metal dissolution was less. Another new technique was developed which measures the ductility of films on metal surfaces by determining by ellipsometry the amount of thinning the film undergoes upon straining the metal. The technique gives values for maximum ductility of the film rather than the fracture strain that other techniques give. Measurements were made on anodic films on Ta, Al and Al-4% Cu. Author (GRA)

**N72-11447#** George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue Fracture and Structural Reliability.
**SLIPLESS FATIGUE IN TITANIUM**
Douglas E. MacDonald and W. A. Wood Apr. 1971 25 p refs
(Contract N00014-67-A-0214-0011)
(AD-725168; TR-7) Avail: NTIS CSCL 11/6

A study by scanning electron-microscope was made of titanium fatigued by alternating torsion at amplitudes confined to its elastic range. A special point was made of distinguishing between the few plastic grains which even in a nominally elastic range develop slip bands and the remaining elastic grains which show no signs of slip. The fatigue which occurs in the plastic grains was studied by an etching technique and shown to be ineffective in comparison with a shear type of transcrystalline fatigue crack which develops and propagates in the elastic grains. Thus in practice an apparently slipless fatigue is possible, here attributed to conditions which allow the grains to build up bands of excessive strain. Author (GRA)

**N72-11448#** Naval Intelligence Command, Alexandria, Va. Translation Div.
**THE DIFFUSION PROCESS FOR TITANIUMIZATION OF STEEL AND ITS USE IN SHIPBUILDING [ISSLEDOVANIYE PROTESSA DIFFUZIONNOGO TITANIROVANIYA STALI I PRIMENEHIYE YEGO V SUDOSTROYENII]**
A. G. Mudrova and N. S. Gorbunov 17 Jun. 1971 8 p refs Transl. into ENGLISH from the publ. "Zharostoykiye i Teplostoykiye Pokrytiya" Leningrad, Nauka, 1969 p 174-180
(AD-725620; NIC-Trans-3220) Avail: NTIS CSCL 11/3

Diffusion saturation of steel articles with titanium is the most effective method of forming protective coatings. Titanium coating is utilized to increase resistance to wear, corrosion, and erosion. The present work establishes the composition of a reaction mixture permitting the titanium coating of steel and cast iron without the use of hydrogen, argon, and other additives in the usual soaking pits. Author (GRA)

**N72-11449#** Defense Documentation Center, Alexandria, Va.
**EUTECTIC ALLOYS, A DDC BIBLIOGRAPHY**
Jun. 1971 153 p refs
(AD-725710; DDC-TAS-71-31) Avail: NTIS CSCL 11/6

The annotated references in the bibliography deal with Eutectic Alloys. Problems dealing with casting, milling, cutting, processing, and mechanical properties are discussed. Subject, title, and personal author indexes are included. Author (GRA)

**N72-11450#** Army Foreign Science and Technology Center, Charlottesville, Va.
**METALLOIDS: A NEW BASIS FOR HEAT-RESISTANT MATERIALS [METALLIDY: NOVAYA OSNOVA ZHAROPROCHNYN MATERIALOV]**
I. I. Kornilov 25 May 1971 21 p refs Transl. into ENGLISH from the publ. "Struktura i Svoystva Zharoprochnykh Metallicheskikh Materialov" USSR
(Proj. T702301-2301)
(AD-725576; FSTC-HT-23-416-70) Avail: NTIS CSCL 11/6

The report discusses intermetallic compounds (metalloids) which show prospects for heat resistant materials. They maintain many properties inherent in metals. Some metalloids such as Ni3Al, NiTi; Ti3Ag, are pliable at high temperatures and sometimes at low temperatures. Metalloids can be mixed as alloys and the results are more heat resistant than the constitutent parts. Author (GRA)

**N72-11451#** Army Foreign Science and Technology Center, Charlottesville, Va.
**HEAT RESISTANT COPPER ALLOYS [ZHAROPROCHNYE MEDNYE SPLAVY]**
A. M. Korolkov, L. M. Gyrova, and E. V. Bezus 26 May 1971 14 p refs Transl. into ENGLISH from the book "Struktura i Svoistva Zharoprochnykh Metallicheskikh Materialov", 1967
(AD-725577; FSTC-HT-23-420-70) Avail: NTIS CSCL 11/6

A study was made on heat resistance, rigidity, and stability at 400 C of a number of copper alloys (Cr, V, Ce, Zr and others). Zr produced the greatest increase in heat resistance; cerium and calcium improved heat resistance, but not as much as zirconium. The hardest copper alloys produced were Cu-Zr-Ce and Cu-Cr-V. Alloys of 2-3% Zr or 1.5-20% (Zr - Ce) proved to be pliable with a good combination of heat resistance and electrical conductibility (not less than 75% of the conductivity of Cu). Stress-rupture strength at 400 C or 100-hour tests was 12-13 kg (force)/sq mm (3-4 times greater than the stability of Cu) and at 600 C, 2.8-3.3 kg (force)/sq mm. Author (GRA)

# 18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

**N72-11452** Washington Univ., Seattle.
**THE BRITTLE FRACTURE OF THERMOPLASTIC POLYMERS AND COMPOSITES**
Kenneth Lee Trachte (Ph.D. Thesis) 1970 288 p
Avail: Univ. Microfilms Order No. 70-18956

The brittle fracture properties of unfilled polyphenylene oxide, polysulfone, polycarbonate, polymethylmethecrylate, glass bead filled polyphenylene oxide, short random glass fiber filled polyphenylene oxide, and short random graphite fiber filled polyphenylene oxide were investigated The variables were testing temperature, filler concentration, filler geometry, filler properties, and adhesion of polymer to the filler. Fracture energy measurements were taken using double edge-notched tensile samples. Tensile strength, tensile strain, and initial elastic modulus were measured for use in calculation of the fracture energy. An overall brittle fracture analysis of each material was presented, considering the fracture energy, tensile strength, tensile strain, and initial elastic modulus values. Dissert. Abstr.

**N72-11453** National Lending Library for Science and Technology, Boston Spa (England).
**THE RHEOLOGICAL PROPERTIES OF SOLID BODIES WITH RANDOMLY DISTRIBUTED INHOMOGENEITIES [REOLOGICHESKIE SVOISTVA TVERDYKH TEL SO SLUCHAINO RASPOLOZHENNYMI NEODNORODNOSTYAMI]**
L. P. Khoroshun Jul. 1971 8 p refs Transl. into ENGLISH from Tepl. Napryazh. Elem. Konst. (Kiev), no. 7, 1967 p 25-30
(NLL-RTS-6332) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.80 or NLL photocopy coupons

The rheological characteristics of materials in the bulk are determined by the shape, distribution and mechanical properties of their component parts. Some rheological properties of ingredients are the same for all materials, due to the production of second order stresses etc. This feature is especially conspicuous in structural materials such as fibre-glass plastics, plastics filled with paper or fabric, granular materials etc., which are built up from several components. The mechanical properties of similar materials, whose component parts are distributed at random, are distributed in a random manner around mean values. Probability methods are employed in the determination of the rheological properties of the bulk material, which means that an infinite series of interacting moments is defined. Unlike the elastic problem, the moments are represented by statistical means derived from random integral operators and random functions.
Author

**N72-11454** National Lending Library for Science and Technology, Boston Spa (England).
**STUDY OF THE PROPERTIES OF A HIGHLY-POROUS TITANIUM DIOXIDE SURFACE [ISSLEDOVANIE SVOISTV POVERKHNOSTI VYSOKOPORISTOI DVUNOKISI TITANA]**
Ts. M. Okropiridze et al Aug. 1971 5 p refs Transl. into ENGLISH from Soobscheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 61, no. 1, 1971 p 81-84
(NLL-RTS-6620) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.50 or 2 NLL photocopy coupons

The absorption of nitrogen vapor on a sample of air-dried titanium dioxide gel is studied by X-ray powder method. Adsorption isotherms of nitrogen vapor show that the adsorbability of titanium dioxide as a result of heat treatment from 20 deg to 300 C in a vacuum increases slightly for a sample calcinated at 100 C and then gradually decreases. Heat treatment at 400 C results in a sharp decrease in nitrogen adsorption. Comparison of nitrogen vapor adsorption values and the graph of the weight loss of the sample shows that the adsorption is barely dependent on the state of hydration of the surface; it is assumed that on the titanium dioxide surface the main adsorption centers are titanium ions Ti(4+ or -). G.G.

**N72-11455** National Lending Library for Science and Technology, Boston Spa (England).
**CARBON MATERIALS**
H. Suzuki and S. Kimura 22 Sep. 1971 28 p refs Transl. into ENGLISH from Zairyo Kagaku (Japan), v. 6, no. 1, 1969 p 23-32
(NLL-LB/G/3060-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The crystal structure and microstructure of graphite, amorphous carbon, pyroltyic carbon, and vitreous carbon are examined. Their structure shows that giant molecules are based on crystallites of graphite structure in which hexagonal network structures of carbon are stacked regularly and combined in a complicated manner. The basic properties of carbon materials are also reiterated. J.A.M.

**N72-11456*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
**INTUMESCENT PAINT CONTAINING NITRILE RUBBER Patent Application**
Paul M. Sawko, inventor (to NASA) Filed 12 Feb. 1971 10 p
(NASA-Case-ARC-10196-1; US-Patent-Appl-SN-115082) Avail: NTIS CSCL 11C

An intumescent agent is provided which contains para-nitroaniline-bisulfate dispersed in a mixture of an acrylonitrile-butadiene copolymer and a phenolic resin. The adhesion and water resistance are both greater than intumescent agents known in the past. NASA

**N72-11457#** Royal Aircraft Establishment, Farnborough (England).
**SPECIMENS AND TEST METHODS FOR CARBON FIBRE REINFORCED PLASTICS. RECOMMENDATIONS BY GOVERNMENT LABORATORIES**
J. B. Sturgeon Feb. 1971 35 p refs
(RAE-TR-71026; UDC-661.66-426) Avail: NTIS

Recommendations are given, which have been agreed to by a number of government laboratories, on methods for determining short-term mechanical properties of unidirectional carbon fiber reinforced plastics. Author (ESRO)

**N72-11458#** Yarsley Research Labs., Ltd. (Gt. Brit.).
**SPECIMEN DESIGN FOR SUSTAINED LOAD TESTING OF PARALLEL-LAID GLASS FIBRE REINFORCED PLASTICS**
D. B. S. Berry and P. R. Farley London Dept. of Trade and Ind. Aug. 1970 15 p
(Contract KS/1/0538/C.B.43(a)2)
(D-MAT-172) Avail: NTIS

The specimen adopted and recommended for use is prepared by making three laminates, two of them to form the reinforcing end pieces and the third for the test piece. The three laminates are then bonded together in a mold using single layers of prepreg as bonding agent. The bonding surfaces are specially prepared by molding on a sheet of woven glass fabric and stripping this off just before bonding, to leave a roughened surface. The test specimens are 1/2 in. wide strips cut from the laminates. Author (ESRO)

**N72-11459#** Wayne State Univ., Detroit, Mich.
**CONTROLLED POLYMERIZATION OF ADSORBED MONOMERS Final Report**
H. K. Livingston Jun. 1971 9 p
(Contract AT(11-1)-1580)
(COO-1580-13) Avail: NTIS

Research progress is reported on controlled polymerization of adsorbed monomers including polymerization of monomers adsorbed on solids (includes radioinduced polymerization of furan), polymerization in built-up monolayers, and synthesis of sheet polymers. NSA

N72-11460# Bendix Corp., Kansas City, Mo. Dept. 400-
**QUALITY DIVISION QUARTERLY, 1 MARCH - 6 JUNE 1970**
May 1971 289 p refs
(Contract AT(29-1)-613)
(BDX-613-404) Avail: NTIS

To determine if stress-cracking has a significant effect on the service life of polycarbonate parts, tests were performed using injection-molded test specimens of Lexan and Merlon polycarbonate material. Samples were dead-loaded in tension to approximately 90 percent yield strength and exposed to atmospheres of 50- and 100-percent relative humidities. After approximately 1 month, no stress-cracks were observed. Tensile, impact, and creep tests were run at various load levels to study the effects of annealing, specimen geometry, and bulk on stress-cracking tendencies. Tensile tests at 165 F, low cycle fatigue tests, and fracture toughness tests were also carried out. Surface residual stresses were studied with stress-cracking liquids. Stress patterns on specimens were studied using standard refractive index immersion fluids, scattered lighting, front lighting, birefringence (photoelasticity), and dark field projection. Voids occurred at 5- to 15-percent strain in tensile tests.
Author (NSA)

N72-11461# Bendix Corp., Kansas City, Mo.
**MEASUREMENT METHOD FOR POLYSTYRENE Final Report**
Ted Matzkanin Jun. 1971 29 p
(Contract AT(29-1)-613)
(BDX-613-355) Avail: NTIS

A flexible Pi scale measuring band and a measuring wheel system, both capable of measuring the diameters of 24- to 42-inch polystyrene billets with an accuracy of + or -0.001 inch and repeatability of + or -0.001 inch, have been developed to measure the shrinkage of soft, porous polystyrene foam billets.
Author

N72-11462# Royal Aircraft Establishment, Farnborough (England).
**THE STRENGTH OF SHEETS AND JOINTS IN UNWOVEN GLASS FIBRE REINFORCED PLASTIC LAMINATES**
F. Clifton and D. L. Mead Nov. 1970 106 p refs
(RAE-TR-70213; UDC-678,046,36) Avail: NTIS

Tests were made in tension, compression, and bending on specimens from a laminated, unwoven glass fiber, composite sheet of various fiber-orientations, and in tension on simple joints in the same types of sheet. The purpose of the exercise was to gain preliminary knowledge of the structural behavior of unwoven fiber composite material. Author (ESRO)

N72-11463# Army Materials and Mechanics Research Center, Watertown, Mass.
**INFRARED RADIATION OF PLASMA-SPRAYED TUNGSTEN, TANTALUM, AND MOLYBDENUM COATINGS**
Albert F. Grenis Jun. 1971 14 p refs
(DA Proj. 1T0-62105-A-238)
(AD-727652; AMMRC-TR-71-10) Avail: NTIS CSCL 11/3

Infrared radiation properties and characteristics of plasma-sprayed tungsten, tantalum, and molybdenum coating surfaces were investigated in the wavelength region extending from 1.0 to 10.0 microns and at temperatures of 1000 K and 1600 K. The normal spectral emittances, integrated normal total emittances, and infrared radiation intensity curves of the refractory metal coating surfaces were found. These properties and characteristics were then compared to those which were known for highly polished surfaces of tungsten, tantalum, and molybdenum. Author (GRA)

N72-11464# Olin Mathieson Chemical Corp., New Haven, Conn. Urethanes Research Dept.
**FLEXIBLE URETHANE RESINS AND COATING MATERIALS DEVELOPMENT Final Report, 25 Feb. 1970 - 24 Feb. 1971**
John E. Pregler Mar. 1971 84 p refs
(Contract N00019-70-C-0309; Proj. 9-0-749-07)
(AD-727596) Avail: NTIS CSCL 11/3

Research studies were conducted on polyurethane coating formulations to develop thermally stable, low temperature flexible films that would be non-yellowing when exposed to weathering. A series of different polyols and crosslinking agents were reacted with an aliphatic diisocyanate, cured into films and physical properties determined. Results of this investigation enabled the selection of the most thermally stable polyol components. Diols, triols and tetrols were investigated. They included polyether, polyester and hydrocarbon backbone structures. Polyesters in combination with an isocyanurate crosslinker provided the most thermally stable polyol combination when reacted with 4,4-methylene bis(cyclohexylisocyanate) and cured. In addition to thermal stability and low temperature flexibility, abrasion resistance, energy of rupture, tensile properties at -65F and 70F, solvent resistance and accelerated weathering properties were determined. Non-photochemically reactive solvents were formulated which conform to 'Rule 66' legislation. Author (GRA)

N72-11465# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.
**ICOSAHEDRAL CARBORANES. 19: THE PREPARATION OF LINEAR TRIFLUOROPROPYL-SUBSTITUTED POLYCARBORANYLENESILOXANES**
Robert N. Scott, Karl O. Knollmueller, Haywood Hooks, Jr., and John F. Sieckhaus Jul. 1971 34 p refs Submitted for publication
(Contract N00014-71-C-0003)
(AD-727575; TR-49; NR-356-431) Avail: NTIS CSCL 07/3

A series of linear trifluoropropyl-substituted polycarboranylenesiloxanes with molecular weights between 3,500 and 13,000 has been prepared by the tetramethyl-guanidine/sulfuric acid catalyzed condensation of various silanol terminated momomers as well as by simple hydrolytic condensation of m-B10H10C2(SiMePfOSiMePfCl)2 and B5H5C2(SiMePfCl)2 (where Pf= -CH2CH2CF3). The polymers containing the C2B5H7 and C2B10H12 carboranes range from hard glasses to viscous gums and rubbers, are more thermally stable than fluorinated silicones with comparable resistance to solvents, and are potentially useful as high temperature fuel tank sealants.
Author (GRA)

N72-11466# Naval Ordnance Lab., White Oak, Md.
**BEHAVIOR OF PMMA CYLINDER UNDER SHOCK LOADING BY PENTOLITE CHARGES**
John O. Erkman 12 Apr. 1971 45 p refs
(AD-726694; NOLTR-70-265) Avail: NTIS CSCL 14/2

The purpose of the work reported was to improve procedures used in calibrating the NOL large scale gap test. Some changes are suggested which should improve the streak camera records of shock propagation in the PMMA cylinders. Data reduction has been examined in some detail in order to find a suitable method for differentiating the data. The application of smoothing and differentiation operations to subsets of the data is the most promising method. It can be applied so that subtle trends in the data are not destroyed. When the data contain noise, more severe smoothing can be used. This suppresses the effect of noise on the derivative of the data, which is the shock velocity, U. Because most of the data used in this report contains too much scatter from shot to shot, it has not been possible to demonstrate that the U = U (X) relation differs from a smooth curve. There is a good deal of evidence, however, that the curve is not as simple as has been reported by most observers.
Author (GRA)

N72-11467# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATION OF SHORT TERM STRENGTH, CREEP, AND IMPACT TOUGHNESS OF GRAPHITE AT 300-3500 K. EXPERIMENTAL PROCEDURE AND RESULTS**
N. N. Dergunov, V. N. Barabanov, V. M. Kurakin, G. G. Zaitsev, and V. I. Strokov 19 Feb. 1971 14 p refs Transl. into ENGLISH from Termoprochnost Materialov i Konstrukt Elementov Sbornik (USSR), no. 5, 1969 p 354-361
(AF Proj. 7351)
(AD-725003; FTD-HT-23-89-71) Avail: NTIS CSCL 11/2

Measurements were made on graphites of different grain sizes. The modulus of elasticity increases steadily in the temperature range 300-2000K, reaches a maximum at 3100K, and then decreases sharply up to 3500K. The magnitude of the activation energy of creep was almost consistent in the temperature range 2300-2900K and indicated that the mechanism was the sliding of dislocations. The high activation energy in the temperature range 2900-3100K indicated that creep was controlled by a diffusion mechanism at these temperatures. The impact strength decreased in the temperature range 300-2300K and then remained almost consistent up to 3000K. GRA

N72-11468# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
**A SURVEY OF PUBLICATIONS DEALING WITH CORROSION IN WIRE ROPE**
Herbert T. Wood Jan. 1971 28 p refs
(Contract N00014-68-A-0506-0001; Proj. Themis)
(AD-725134; Rept-71-3) Avail: NTIS CSCL 13/9

A research of the literature (both the journal literature and the report literature) was conducted to collect all work dealing with the corrosion and prevention of corrosion of wire rope. A discussion of the various types of corrosion, cathodic protection, coatings, and lubricants is given along with references for these topics. Forty-one references are included. Author (GRA)

N72-11469# Ohio State Univ. Research Foundation, Columbus.
**DEGRADATION MECHANISMS OF PIGMENTED COATINGS Final Report, 1 Dec. 1969 - 1 Jan. 1971**
William B. Campbell and Joe K. Cochran Wright-Patterson AFB, Ohio AFML Mar. 1971 71 p refs
(Contract F33615-70-C-1197; AF Proj. 7342)
(AD-725754; AFML-TR-71-42-Pt-1) Avail: NTIS CSCL 11/3

Two different types of polydimethylsiloxane formulated with a rutile titanium dioxide pigment were evaluated as polymeric thermal control coatings. Oxygen permeability, diffusion, and solubility in these coatings were measured for various temperatures. It was noted that diffusion and permeability coefficients decreased as pigment concentration increased. Morphological investigations comparing surface roughness and surface area to the ultraviolet stability of a zinc orthotitanite coating indicated that pigment surface area is directly related to the increase in solar absorptance. Author (GRA)

N72-11470# Army Foreign Science and Technology Center, Charlottesville, Va.
**ACOUSTIC FATIGUE IN POLYMER MATERIALS [AKUSTICHESKAYA USTALOST POLIMERKYKH MATERIALOV]**
Yu. S. Urzhumtsev and S. L. Skalozub 17 May 1971 34 p refs Transl. into ENGLISH from Mekh. Polim. (Riga), v. 1, 1969 p 108-26
(Proj. T702301-2301)
(AD-725691; FSTC-HT-23-731-71) Avail: NTIS CSCL 11/9

The report presents a short survey of works devoted to the construction of test equipment and methods of testing materials for high-frequency cyclic loading as well as several aspects of acoustic fatigue in polymer materials. Principal trends in future investigations are also discussed. GRA

N72-11471# Raytheon Co., Waltham, Mass. Research Div.
**MICROWAVE HIGH DIELECTRIC CONSTANT MATERIALS Final Technical Report, 1 Jul. 1969 - 28 Feb. 1971**
Dennis W. Readey, Edward A. Maguire, Curtis P. Hartwig, and Daniel J. Masse Fort Monmouth, N. J. ECOM Jun. 1971 125 p refs
(Contract DAAB07-69-C-0455)
(AD-725578; S-1315; ECOM-0455-F) Avail: NTIS
CSCL 11/2

The intent of the program was to develop high dielectric constant, temperature compensated microwave ceramic materials. The approach used was to form two-phase bodies consisting of a titanate phase and rutile as the second phase. Empirical mixing rules predict that by mixing two dielectrics, one having a positive temperature coefficient and the other negative, a compensated material can be achieved at one particular composition. The microwave properties of rutile had been investigated and was found to have a very negative coefficient. Therefore, the initial phase of the program was to find titanate compounds having positive temperature coefficients to form a two-phase mixture with TiO2. As a result of this phase of the program four essentially temperature-insensitive high-dielectric-constant materials were developed. They are: BaTi4O9, Li2O: 1.5 TiO2, 84 percent MgTi2O5 - 16 percent TiO2, and a Zn2TiO4 - TiO2 mixture. Later in the program, a non-compensated material having a dielectric constant near k 50 was desired. Therefore, a two-phase mixture of 72 percent BaTi4O9 28 percent TiO2 was developed to satisfy this requirement. Microwave dielectric properties were measured on all of these materials, as well as thermal expansion coefficient, modulus of rupture, hardness, and water absorption. During the final phase of the program, pilot plant quantities of BaTi4O9 and the 72 percent BaTi4O9 - 28 percent TiO2 material were fabricated and delivered.
Author (GRA)

N72-11472# Army Foreign Science and Technology Center, Charlottesville, Va.
**OBTAINING PIGMENTED POLYAMIDE COATINGS [POLUCHENIE OKRASHENNYKH POLYAMIDNYKH PLENOK]**
T. D. Astanina, N. S. Khromova, and S. A. Pavlov 17 May 1971 9 p refs Transl. into ENGLISH from Kozh.-Obuvn. Prom. (Moscow), no. 11, Nov. 1969
(AD-725615; FSTC-HT-23-509-71) Avail: NTIS CSCL 11/3

Properties of chemically colored coatings obtained from AK 60/40 mixed polyamide and Type 89 epoxy resin are discussed. Special attention is devoted to metaphenylene diamine (MFDA) and its effect on the coloration-structuring process in polymers. TEhG-1 epoxy resin is also considered. GRA

N72-11473# Naval Ordnance Lab., White Oak, Md.
**SOLVENT REMOVAL OF EC-2273 POTTING COMPOUND FROM F-4 AIRCRAFT ELECTRICAL COMPONENTS Final Report, 1 Jul. 1969 - 31 Dec. 1970**
Porter W. Erickson and Joseph M. Augl 14 May 1971 32 p refs
(NOL Proj. 341/AIR-520C01)
(AD-725493) Avail: NTIS CSCL 13/8

A safe, fast, and effective solvent system was developed for the removal of EC-2273 encapsulant. This material, which is now showing signs of failing, is the potting compound used in several hundred components of a large number of Navy F-4 aircraft. The preferred solvent system consists of a mixture of N-methyl-2-pyrollidone (M-Pyrol), benzyltrimethylammonium hydroxide and methanol. Virgin, as well as deteriorated, EC-2273 is cleanly removed from a typical electrical connector simply by immersion of the component in the solution for a period of a few hours. Author (GRA)

N72-11691# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.
**INVESTIGATION OF FIRE EXTINGUISHING POWDERS BY MEANS OF A NEW MEASURING PROCEDURE**
R. Fiala and G. Winterfeld *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs (See N72-11668

02-27)
Avail: NTIS HC $6.00/MF $0.95

# 19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also 08 Computers.

**N72-11474** Pennsylvania State Univ., University Park.
**GRADIENT BIASED RANDOM SEARCH Ph.D. Thesis**
Antonio Frank Pensa 1969 139 p
Avail: Univ. Microfilms Order No. 70-19447

The convergence of the gradient biased random search is demonstrated using the Dvoretzky conditions of stochastic approximation. The search scheme is optimized with respect to its rate of convergence on a noisy unimodal index of performance surface. The optimization technique is based upon a continuous approximation of the discrete search algorithm. Solutions of this approximating stochastic differential equation are found to be trajectories of a Markovian diffusion process. A search is defined in terms of these continuous trajectories. The values of the search coefficients which minimize this search cost function are found using Markovian optimization technique. The gradient biased random search, the Kiefer-Wolfowitz stochastic approximation search, and the sequential random search are each used individually on a hybrid computer. Dissert. Abstr.

**N72-11475** Washington Univ., Seattle.
**SCATTERING BY FINITE VOLUME DIELECTRIC OBJECTS Ph.D. Thesis**
Douglas Arthur Ross 1970 85 p
Avail: Univ. Microfilms Order No. 70-19653

The problem of scattering by finite volume dielectric objects is approached by the use of eigenfunctions appropriate to a spherical scatterer. An expansion for the fields interior to the scatterer is made and the coefficients evaluated by means of a Neumann expansion in terms of a difference operator. This difference operator involves the difference between the exact scattering operator and an approximation to it derived from an approximate solution to the problem. The method is applied to the scattering by a red blood cell. The scattering cross section for the red blood cell is found to depend strongly on the orientation of the cell relative to the direction of the incident field at optical frequencies. Dissert. Abstr.

**N72-11476** California Univ., Los Angeles.
**LIMIT THEOREMS FOR INFINITE PARTICLE SYSTEMS**
Neil Alan Weiss (Ph.D. Thesis) 1970 122 p
Avail: Univ. Microfilms Order No. 70-19915

Limit theorems are proved for systems in which the particles are assumed to move independently according to the transition matrix P(x,y) of a Markov chain. The P(x,y) is the transition matrix for a transient aperiodic random walk (sums of independent and identically distributed random variables). Suppose at time 0 there are A sub 0 (x) particles at x in some countable set, and A sub 0 (x) are independent nonnegative integer valued random variables whose moments satisfy given conditions. Information is obtained concerning the number of particles in B per unit time, their asymptotically normal distribution, the number of distinct particles to hit B by time n, and the number of particles which leave B by time n, never to return.
Dissert. Abstr.

**N72-11477** Louisiana State Univ., Baton Rouge.
**SUFFICIENTLY EUCLIDEAN BANACH SPACES AND FULLY NUCLEAR OPERATORS**
Charles Patrick Stegall, Jr. (Ph.D. Thesis) 1970 47 p
Avail: Univ. Microfilms Order No. 70-18561

A study is presented of the conjecture that if E and F are Banach spaces and all operators from E to F are nuclear, then E or F must be finite dimensional. A partial solution is given to this conjecture. Two new properties of Banach spaces are introduced. The properties are called sufficiently Euclidean and Property S. It is shown that the classical reflexive spaces are sufficiently Euclidean. A class of operators between two Banach spaces is defined, called the fully nuclear operators and a determination of the structure of this class in certain cases is made. The principal result is that if all the continuous linear operators from a Banach space E to a Banach space F are fully nuclear then one of E,F must be finite dimensional. Dissert. Abstr.

**N72-11478** Purdue Univ., Lafayette, Ind.
**DIGITAL FILTERS Ph.D. Thesis**
Stephen Ray Harrison 1970 182 p
Avail: Univ. Microfilms Order No. 70-18657

Several techniques are reported for designing digital filters which approximate continuous filters. Various discrete approximations to the continuous convolution integral are realizable as the solution of difference equations. These difference equations are the equations for digital filters. Rectangular quadratic and higher order numerical integration rules lead to a continuum of digital filters of first, second and higher order respectively, making this a highly flexible approach for designing digital filters. Various discrete approximations to the differential equations characterizing the continuous system result in difference equations characterizing the digital filter. Discussed are two first order approximations and a quadratic approximation. A frequency domain approach is presented whereby the frequency characteristics of the digital filter are napped closer to those of the continuous filter by a multiplicative compensating polynomial. The harmonic response of various standard examples are compared with one another and with the results of other methods of realizing digital filters.
Dissert. Abstr.

**N72-11479** Princeton Univ., N.J.
**ON THE MODULAR DECOMPOSITION OF AUTONOMOUS SEQUENTIAL MACHINES Ph.D. Thesis**
William Frank King, III 1970 85 p
Avail: Univ. Microfilms Order No. 70-19787

The decomposition of an autonomous sequential machine into an interconnection of identical modules was investigated. Each module has k input leads and one output lead and has the structure of a Moore machine. Interconnection is understood to mean that the output of any module may be connected to any input of any module, that each input of a module is connected to the output of some module, and that no two outputs are connected together. The decomposition is accomplished by an iterative process. Modular decomposition was generalized to a module with a set of restricted start states and to a set of modules with restricted start states. For each of these generalizations, the necessary and sufficient conditions for output sufficiency are given in terms of the pair functions. Several problems for modular decomposition are proven to be recursively undecidable. Dissert. Abstr.

**N72-11480** Columbia Univ., New York.
**OPTIMAL CHECKING EXPERIMENTS FOR SEQUENTIAL MACHINES Ph.D. Thesis**
Edward Po Chiu Hsieh 1969 206 p
Avail: Univ. Microfilms Order No. 70-18817

Three closely related problems in sequential machine fault detection were investigated. They were 1) the efficient use of the availability of sequences other that distinguishing sequences (DS) alone in the design of checking experiments, 2) systematic optimization of the length of checking experiments, and 3) optimal checking experiments for faults that cause an increase in the number of states. In most existing procedures for designing checking experiments, the optimization of length is either largely heuristic in nature or limited in scope. A precedure was developed for the design of optimal experiments under a more general organization, in which the efficient use of DS, compound

DS, RS (resolving sequence), compound RS, and simple I/O sequences can be made with one unified procedure. Systematic optimization is an integral part of the design procedure.
Dissert. Abstr.

N72-11481 California Univ., Los Angeles.
**THE IDENTIFICATION OF CONSTRAINED SYSTEMS WITH HIGH DIMENSIONS Ph.D. Thesis**
Po Cheung Yue 1970 260 p
Avail: Univ. Microfilms Order No. 70-19920

Stochastic systems characterized by a finite set of unknown parameters and with an unknown initial state are identified. The systems are linear, time-invariant, multidimensional, discrete time, and dynamic in nature. There are Gaussian random disturbance of unknown characteristics acting on the system and also Gaussian white-noise contaminating the observations. The method of maximum likelihood is established on a rigorous basis by presenting a complete asymptotic theory. The maximum likelihood estimates of the system parameters are shown to be strongly consistent and converge in mean square (up to equivalence) if certain system properties and input condition are satisfied. These conditions can be determined prior to identification and completely generalize the pioneer work of Astrom's for the special scalar-input, scalar-output case using a one-noise model. The initial-state estimate of an unknown system is shown to be asymptotically unbiased and have uniformly bounded covariance.
Dissert. Abstr.

N72-11482 Pennsylvania State Univ., University Park.
**AN OPTIMAL CONTROLLER FOR A PLANT WITH STOCHASTIC PARAMETERS Ph.D. Thesis**
Hubert Jon Thomas 1969 74 p
Avail: Univ. Microfilms Order No. 70-19482

A control law is developed for a linear, random parameter system which minimizes the expectation of a given quadratic cost functional. The Maximum Principle is used and a Riccati-type differential equation is obtained which is used to give a feedback gain matrix to produce the control signal. A method is also developed for obtaining the output mean and autocorrelation function for such a system with a given input. A second-order example is given with several different weighting matrices used in the cost functional, and the output mean and autocorrelation of the system driven by the optimal control are compared with those resulting from several suboptimal control laws.
Dissert. Abstr.

N72-11483 Purdue Univ., Lafayette, Ind.
**MULTISTEP AND MODIFIED INTEGRATION METHODS FOR THE SIMULATION OF POWER SYSTEM DYNAMICS Ph.D. Thesis**
Sarosh Naval Talukdar 1970 102 p
Avail: Univ. Microfilms Order No. 70-18748

Iterative algorithms are developed for the solution of implicit multistep equations. Experimental investigations indicate that implicit multistep methods using these algorithms are at least as accurate and two to three times faster than Runge-Kutta methods with the same step size. The modified methods discussed permit the use of step sizes two to five times those necessary to assure numerical stability when using conventional one-step and multistep methods. An algorithm is developed for the computation of the stable approximations to matrix exponentials of the form, e to the S power, that are required by modified methods.
Dissert. Abstr.

N72-11484# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
**ON MIXING MARKOV CHAINS Ph.D. Thesis [ZUR MISCHUNG MARKOFFSCHER KETTEN]**
Hans-Joachim Hatje 1971 38 p refs In GERMAN
Avail: NTIS

Mixed Poisson processes with discrete time parameters and countable numbers are used to analyze two homogeneous discrete Markov chains by using a mixing criteria to limit the class of mixable processes in relation to the recurrence behavior of the initial chains. It is concluded that two irreducible, aperiodic, homogeneous Markov processes with equal realized number chains and recurrence behavior are only Markov mixable if they are purely transient. Ergodic Markov chains are not mixable.
Transl. by G.G.

N72-11485# Centre National de la Recherche Scientifique, Toulouse (France).
**METHOD OF GRAPHICAL SYNTHESIS OF BOOLEAN FUNCTIONS USING THE NOR AND NAND OPERATIONS [METHODE DE SYNTHESE GRAPHIQUE DES FONCTIONS BOOLEENNES A L'AIDE D'OPERATEURS NI ET ON]**
J. C. Bertrand, J. C. Ippolito, C. Durante, and F. Prunet [1969] 32 p refs In FRENCH
(Publ-781) Avail: NTIS

A problem of particular interest in the synthesis of logic functions is that of integrated NOR logic modules which are compatible with NAND modules. A method of synthesis simultaneously utilizing the two operators is discussed. Their association is presented in terms of a synthesis involving a minimum of modules. A number of relations are established between the OR, AND, NOR, and NAND operators. A graphic representation is given for an operator, from which theorems are derived permitting the elaboration of a complete method of graphical synthesis. Taking into account the technological constraints of input and sorting, a graphic method is presented for reducing the gates of a module.
Transl. by K.P.D.

N72-11486# Tokyo Univ. of Education (Japan). Dept. of Physics.
**HOW TO CONSTRUCT WAVE EQUATIONS WHEN MASS LEVELS ARE KNOWN**
Tadashi Miyazaki Jun. 1971 27 p refs Sponsored in part by the Yukawa Post Doctoral Fellowship Prepared in cooperation with Tokyo Univ.
(TUEP-71-28) Avail: NTIS

The unified treatment is formulated for the construction of wave equations when mass spectra are given. Examples of rotational or linearly rising mass levels are considered.
Author

N72-11487# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**GAUGE INVARIANCE AND UNIQUENESS OF THE RENORMALISATION OF DUAL MODELS WITH UNIT INTERCEPT**
A. Neveu and J. Scherk Aug. 1971 25 p refs
(LPTHE-71/43) Avail: NTIS

The consequences of gauge invariance for the unitarization and renormalisation of dual models with unit intercept are re-examined in the light of the connection of those models with quantum electrodynamics and massless Yang-Hills fields. It is shown that the arbitrary constant in the renormalisation procedure must be interpreted, at least in order q squared, as a coupling constant and wave-function renormalization. The main consequence is the absence of renormalization of the intercept of the leading trajectory, which, at least in order q squared, and presumably to all orders, remains fixed at one.
Author

N72-11488# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**FIELD THEORY INTERPRETATION OF SUPERGAUGES IN DUAL MODELS**
J.-L. Gervais and B. Sakita Jul. 1971 13 p refs
(LPTHE-71/41) Avail: NTIS

Possible new invariances of generalized dual models are discussed in the context of the functional integral formulation. The operators relevant to new gauges of those models, such as those obtained by Neveu and Schwarz, are derived as infinitesimal generators of new field transformations which leave the action integral invariant.
P.N.F.

N72-11489# Paris Univ., Orsay (France). Lab. de Physique Theorique et Particules Elementaires.
**THE INVERSE SCATTERING PROBLEM AT FIXED ANGULAR MOMENTUM FOR NONLOCAL SEPARABLE INTERACTIONS**
K. Chadan Jul. 1971 26 p refs Presented at the Workshop on the Math. of Profile Inversion, Moffett Field, Calif., 12-16 Jul. 1971
(Rept-71/33) Avail: NTIS

A brief survey is given of the inverse problem for nonlocal separable interactions. This problem can be solved exactly by integration. It amounts to solving singular integral equations of the Hilbert-Mushkhelishvili type, which are applicable in areas such as elasticity theory and dispersion relations in high energy physics. The inverse problem for nonlocal potentials does not necessarily have a unique solution if only the S-matrix on the energy shell is given. Author

N72-11490# Technische Hogeschool, Delft (Netherlands).
**THE KALMAN-BUCY FILTER AND ITS BEHAVIOUR WITH RESPECT TO SMOOTH PERTURBATIONS OF THE INVOLVED WIENER-LEVY PROCESSES** Ph.D. Thesis
Peter Arnold Ruymgaart 30 Jun. 1971 159 p refs
Avail: NTIS

A recursive scheme for determining estimates, the so-called Kalman-Busy filter, is described. The state system is linear, its homogeneous part is deterministic, its inhomogeneous part is a white noise process, and its initial conditions are random. At any instant, the observation is a linear function of the state and a new white noise process is added to it. Thus, the observation noise generated in an observation device is modeled as a smooth perturbation of a white noise process. The stability of the estimates of a class, comprising interpolated and extrapolated values, both of Kalman-Bucy type and of the type of Wiener and Komogorov is established to a certain extent by mean of calculus. G.G.

N72-11491*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
**COMPUTATIONAL INVESTIGATIONS OF LOW-DISCREPANCY POINT SETS**
Tony T. Warnock 27 Aug. 1971 29 p refs
(Grant NGL-50-002-001; NSF GB-18665)
(NASA-CR-123312; WIS-TCI-453) Avail: NTIS CSCL 12A

The quasi-Monte Carlo method of integration offers an attractive solution to the problem of evaluating integrals in a large number of dimensions; however, the associated error bounds are difficult to obtain theoretically. Since these bounds are associated with the L2 discrepancy of the set of points used in the integration. Numerical calculations of the L2 discrepancy for several types of quasi-Monte Carlo formulae are presented. Author

N72-11492# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**THE METHOD OF MATCHED ASYMPTOTIC EXPANSIONS APPLIED TO PROBLEMS INVOLVING TWO SINGULAR PERTURBATION PARAMETERS**
Jean-Sylvestre Darrozes 1971 12 p refs Presented at 10th Biennal Fluids Dyn. Symp., Rynia, Poland, 6-12 Sep. 1971
(ONERA-TP-1007) Avail: NTIS

The method of matched asymptotic expansions in fluid dynamics was extended in order to solve problems involving two small parameters, alpha and eta, and a variable x. For any function sigma(eta) going to zero, and for vanishing values of eta, an intermediate description was defined. Alpha and eta in such a description go to zero simultaneously, the value of the ratio alpha/sigma(eta) being fixed, and the classical method of matched asymptotic expansions leads to a composite expansion of the solution, which is unique and of the form f(x,alpha,eta). The functions sigma sub i (eta) = 1,...p which lead to dissimilar behavior of the solution were characterized, and the nonexistence of a function intermediate between two successive elements of the set sigma sub i was established. A generalized composite expansion of the function f(x,alpha,eta), which is uniformly valid for any, x, independent of the path by which (alpha,eta) approaches (0,0), can be written, using one or more intermediate descriptions. Author

N72-11493# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
**QUANTUM TRANSITION CALCULATIONS FOR GAS SURFACE INTERACTIONS**
A. E. Sisson Apr. 1971 42 p refs
(UTIAS-TN-163) Avail: NTIS

It is first shown that the interaction potential between a gas atom and a solid surface with a finite temperature can be conveniently represented by a two-dimension Fourier series with the coefficients being functions of the distance between the atom and the surface. This representation is useful and shows the basis for the one-dimensional assumption used in the hard- and soft-cube models. Secondly the quantum mechanical analogs of the hard- and soft-cube models are used to calculate the probabilities for multiple phonon transitions for the gas surface collisions. Both analytical and numerical results show that it is feasible to use helium as a surface probe. Author

N72-11494# Laboratoire d'Automatique et de Ses Applications Spatiales, Toulouse (France).
**STUDY OF THE SOLUTIONS TO THE RECURSIVE EQUATION x SUB (n PLUS 1) EQUALS y SUB n PLUS F(x SUB n); y SUB (n PLUS 1) EQUALS MINUS x SUB n PLUS F(x SUB (n PLUS 1)) [ETUDE DES SOLUTIONS DE LA RECURRENCE x SUB (n PLUS 1) EQUALS y SUB n PLUS F(x SUB n); y SUB (n PLUS 1) EQUALS MINUS x SUB n PLUS F(x SUB (n PLUS 1))]**
C. Mira and J. L. Abatut 2 Jun. 1971 22 p refs In FRENCH
(LAAS-811) Avail: NTIS

An analysis of recursive equations which form a conservative system, is carried out by the identification method. This form or recurrence is used when studying transverse motion of particles in an accelerator with alternate gradient. ESRO

N72-11495# Sandia Labs., Albuquerque, N.Mex. Numerical Fluid Dynamics Div.
**ON ARTIFICIAL VISCOSITY**
Patrick J. Roache Jul. 1971 26 p refs Sponsored by AEC
(SC-RR-710301) Avail: NTIS

The usual analysis for the implicit artificial viscosity of finite difference analogs of the linear advection equation is shown to be ambiguous, with different results obtained for transient and steady state problems. The ambiguity is easily resolved for the inviscid equation, but for the advection-diffusion equation, the steady state analysis is shown to be applicable to steady state problems. It is demonstrated that the currently most popular methods, touted as having no artificial viscosity, actually do have such when applied to steady state problems. Author (NSA)

N72-11496# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
**CONFORMALLY PLANE COSMOLOGICAL SOLUTIONS OF THE AXIAL SYMMETRY**
N. P. Bondarenko 1971 20 p refs In RUSSIAN
(ITF-71-16-P) Avail: AEC Depository Libraries

The exact solutions for the axial generalization of Friedmann-Lemaitre's solutions are found and their physical interpretation as cosmological solutions is given. The cosmological models described by these solutions are anisotropic and nonhomogeneous in the sense of the Zelmanov criteria and allow the regular minimum of the gauge factor. Red shift and distortion of galaxies are investigated. Author (NSA)

N72-11497# Battelle-Northwest, Richland, Wash.
**TANDEM METHOD FOR FINDING UNCONSTRAINED MINIMA IN NONLINEAR LEAST-SQUARES PROBLEMS:**

**PROGRAM LEARN-I-C**
D. A. Kottwitz Jun. 1971 31 p refs
(Contract AT(45-1)-1830)
(BNWL-1590) Avail: NTIS

A new iterative method has been developed for finding minima in unconstrained, nonlinear least squares problems with a moderate number of parameters. Based on the complete second-order Taylor expansion of the sum of squares, the scheme selectively uses two types of steps through the iteration. One type, found by Newton's method, has rapid terminal convergence. The other, based on a modified gradient method, efficiently avoids saddle points. The combination, together with careful attention to the control of step size and to convergence tests, provides a high degree of reliability and stability. The algorithm has been adapted for use in the powerful least squares program LEARN (written in FORTRAN 5 for the UNIVAC 1108). Information on programming and input-output details is included.
Author (NSA)

N72-11498# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
**PAIR EFFECTS IN RANDOM LATTICES: A GENERALIZED C.P.A. AND ITS EQUIVALENCE TO DIAGRAMMATIC EXPANSIONS**
B. G. Nickel and J. A. Krumhansl Jul. 1971 8 p refs
(Contract AT(30-1)-3699)
(NYO-3699-58) Avail: NTIS

A generalization of the coherent potential approximation that is exactly equivalent to the self-consistent diagrammatic sumxation techniques is discussed. Explicit expressions for the pair case are given.
Author

N72-11499# Michigan Univ., Ann Arbor. Computer Information and Control Engineering.
**DESIGN OF DECOUPLED MULTIVARIABLE CONTROL SYSTEMS Ph.D. Thesis**
John R. Pivnichny and E. G. Gilbert Mar. 1971 161 p refs
(Grant AF-AFOSR-1767-69; AF Proj. 9749; ORA Proj. 026450)
(AD-724742; TR-026450-1-T; AFOSR-71-1635TR) Avail: NTIS CSCL 12/1

The report is based on the decoupling theory developed by Gilbert and the computer program developed by Gilbert and Pivnichny. The general objective is a design technique for multivariable control systems which involves decoupling minimization of error and control amplitudes and the reduction of the effects of disturbance inputs and plant parameter variations. Computer realization of this objective is in part demonstrated by a number of practical examples, including several involving flight control.
Author (GRA)

N72-11500# Colorado State Univ., Fort Collins. Dept. of Statistics.
**SOME NEW RESULTS IN THE COMBINATORIAL THEORY OF BALANCED ARRAYS OF STRENGTH FOUR WITH 2 LESS THAN OR EQUAL TO MU SUB 2 LESS THAN OR EQUAL TO 6**
J. N. Sirvastava and D. V. Chopra Wright-Patterson AFB, Ohio ARL Apr. 1971 42 p refs
(Contract F33615-67-C-1436; AF Proj. 7071-00-12)
(AD-727796; ARL-71-0072) Avail: NTIS CSCL 12/1

Various simple but stringent conditions are given which are necessary for the existence of certain balanced arrays (B-arrays, or BA) of strength four, 2 symbols, and index set (mu sub O, mu sub 1, mu sub 2, mu sub 3, mu sub 4) with 2 < or = mu sub 2 < or = 6. Necessary and sufficient existence conditions were obtained for m-rowed B-arrays of strength four and m > 6, with m > 6. Also, apart from the case mu sub 2 = 1, the range (mu sub 2 < or = 6) corresponds to important applications in the theory of factorial designs.
Author (GRA)

N72-11501# RAND Corp., Santa Monica, Calif.
**ESTIMATION IN A MODEL THAT ARISES FROM LINEARIZATION IN NONLINEAR LEAST SQUARES ANALYSIS**
L. H. Wegner Apr. 1971 71 p refs
(Contract F44620-67-C-0045)
(AD-725021; R723-PR) Avail: NTIS CSCL 12/1

The report contains explicit formulas and a JOSS program for obtaining the minimum variance Gauss-Markov or best linear unbiased (BLUE) estimates when a directly observed parameter vector and another parameter vector are related by a possibly nonlinear relationship, and the least squares estimation procedures is linearized. The work was motivated by the need to locate a radar by indirect measurements--either directions or times of arrival of the radar signal--from aircraft whose locations were also indirectly observed by range, azimuth, and range-difference measurements from ground stations--all with some error. However, the results have wide applicability to estimation and error analysis in many real-world situations, such as combining measurements from several trackers. As the covariance matrix of the estimates evaluated at the true values of the estimated quantities generalizes the classical propagation of error variance formula, the computerized covariance matrix is a versatile tool for error analysis of complex systems.
Author (GRA)

N72-11502# Wisconsin Univ., Madison. Mathematics Research Center.
**STABILITY OF UNIFORM SOLUTIONS OF THE NAVIER-STOKES EQUATIONS IN n DIMENSIONS**
George Knightly Mar. 1971 49 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-725082; MRC-TSR-1085) Avail: NTIS CSCL 12/1

The stability of the uniform solutions of the Navier-Stokes equations on all of R to the nth power, n greater than or equal to 3, was proven for a class of perturbations that are small but not necessarily square-integrable. Uniform estimates on the rate of decay are given.
Author (GRA)

N72-11503# Virginia Univ., Charlottesville. Div. of Applied Mathematics and Computer Science.
**BOUNDARY VALUE PROBLEMS Final Report**
Gordon E. Latta May 1971 96 p refs
(Contract F44620-68-C-0019; AF Proj. 9749)
(AD-724703; AMCS-3438-101-71U; AFOSR-71-1710TR) Avail: NTIS CSCL 12/1

Two main lines of research were investigated. The first deals with extensions of self-adjointness and orthogonality to encompass eigenfunction expansions for which the classical Sturm-Liouville theory breaks down. The second line of research deals with a class of singular integral equations arising in the solution of the conductor potential of an annulus. Several theses and journal publications are included supporting this investigation.
Author (GRA)

N72-11504# Louisiana State Univ., Baton Rouge. Dept. of Electrical Engineering.
**NUMERICAL SOLUTION OF SINGULAR CONTROL PROBLEMS M.S. Thesis. Interim Report**
Policarpo Simose Jan. 1971 138 p refs Sponsored by the Creole Found. and the Intern. Inst. of Educ.
(Contract F44620-68-C-0021; AF Proj. 7921; Proj. Themis)
(AD-725740; AFOSR-71-1795TR) Avail: NTIS CSCL 12/1

In the thesis, three different methods are used in the optimization of control problems with the aid of digital computers. All three methods are extended to find singular solutions. The general technique used is to assume a nonoptimal control u sup m and compute a delta u which will drive the control closer to an optimal in order to minimize an integral cost function. The control must satisfy inequality constraints of the form /u(t)/+ or = k, where k is a constant. The three methods used are optimum gradient, conjugate gradient, and parallel tangent. Two examples are presented with their respective analytical solutions and numerical solutions using each of the above methods. Comparisons are shown between the analytical and numerical solutions.
Author (GRA)

N72-11505# Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.
**PROPAGATION OF COVARIANCE MATRIX FOR SYSTEM SUBJECTED TO RANDOM UNBIASED NOISE, VOLUME 1**
Toney R. Perkins and James F. Leathrum Feb. 1971 119 p refs
(AD-725500; AMSAA-TR-48-Vol-1) Avail: NTIS CSCL 12/1

A model and algorithm have been developed for propagating the covariance matrix when a missile is subjected to random unbiased noise in flight. The statistical characteristics of the noise are modeled as a Markov process of known but time-varying covariance and time correlation. The techniques developed by Kalman and Bucy are used to estimate the statistics of the dependent variables by a deterministic computation.
Author (GRA)

# 20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also 13 Geophysics, and 30 Space Sciences.

N72-11506 New York Univ., N.Y. School of Engineering Sciences.
**MEASUREMENTS OF ATMOSPHERIC TURBULENCE A FEW METERS ABOVE THE SEA SURFACE WITH A THREE COMPONENT THRUST ANEMOMETER Ph.D. Thesis**
Stanley Irwan Adelflang 1969 86 p
Avail: Univ. Microfilms Order No. 70-19277

An analysis is given of atmospheric turbulence data obtained a few meters above the sea with a thrust anemometer during neutral to stable conditions. The intensity of turbulent fluctuations of the horizontal wind components, normalized with respect to the friction velocity, is a function of stability. The normalized turbulence intensity of the vertical component is not strongly related to stability and may be approximated by a constant. The drag coefficient is related to a stability parameter defined by the radio of the air-sea temperature difference to the square of the mean wind speed. Based on a least squares analysis, the quadratic function relating the drag coefficient to the stability parameter approaches a constant at high wind speeds; at low wind speeds the drag coefficient is strongly related to the stability parameter. The behavior of the spectra of all components in the inertial subrange indicates a more rapid decrease in energy than that which is predicted theoretically but it is in agreement with the behavior of other spectra derived from measurements over land during stable conditions. The non-dimensional spectra of the longitudinal and vertical components have more energy at low frequencies in comparison to land spectra.
Dissert. Abstr.

N72-11507# National Oceanic and Atmospheric Administration, Washington, D.C.
**NATIONAL HURRICANE OPERATIONS PLAN**
Jun. 1971 122 p
(NOAA-FCM-71-6) Avail: NTIS

The procedures and agreements are presented which were reached at the annual Interdepartmental Hurricane Warning Conference. The responsibilities and functions are specified for the federal agencies cooperating in support of the tropical cyclone warning service.
D.L.G.

N72-11508# Deutscher Wetterdienst, Offenbach am Main (West Germany).
**REPORTS FROM THE GERMAN WEATHER SERVICE, VOLUME 16, NO. 121: CONTRIBUTION TO THE CHANGE OF TROPICAL TURBULENT FLOWS INTO INTENSIVE NONTROPICAL HURRICANES [BERICHTE DES DEUTSCHEN WETTERDIENSTES, BAND 16, NR. 121: BEITRAG ZUR UMWANDLUNG TROPISCHER WIRBELSTUERME IN INTENSIVE AUSSERTROPISCHE ZYKLONEN]**
Tillmann Mohr 1971 31 p refs In GERMAN; ENGLISH summary
Avail: NTIS

The transformation of torpical storms into extratropical cyclones and the regeneration of the transformed storms is investigated by selected cases, especially by typhoon DINAH (1967). It is shown that the transformation is due to the weakening of the vertical, convective and the intensification of the horizontal, advective processes in the northbound tropical storms. The regeneration happens if a superposition of a fast travelling upper air trough on the transformed tropical storm took place. The following conditions must be satified: 1. the trough is not connected with an intensive surface low, 2. an appreciable divergence zone is observed ahead of the advancing trough.
Author

N72-11509# National Weather Service, Silver Spring, Md. Techniques Development Lab.
**AIR-SEA ENERGY EXCHANGE IN LAGRANGIAN TEMPERATURE AND DEW POINT FORECASTS**
Ronald M. Resp Oct. 1971 26 p refs
(NOAA-TM-NWS-TDL-43; UDC-551.509.313) Avail: NTIS

A three-dimensional trajectory model was updated to include effects of air-sea interactions. Output from the model is transmitted via facsmile for guidance in severe-storm forecasting. A quasidynamic model was developed to correct underforecasting by simulating the addition of latent and sensible heat to a column of air moving over water along a surface trajectory. Subsequent changes in the surface air temperature were assumed to be a function of the initial lapse rate, initial air temperature, sea surface temperature, and length of over-water trajectory. Verification statistics for 80 stations showed significant reductions in the root mean square error and bias, due to elimination of large errors in a small number of forecast soundings along or near coastal waters.
Author

N72-11510# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
**AN OPERATIONAL LINEAR LEE WAVE MODEL FOR ARBITRARY BASIC FLOW AND TWO-DIMENSIONAL TOPOGRAPHY**
E. Reiter Apr. 1970 89 p refs
(NCAR-70-44) Avail: NTIS

A partial survey of recent theoretical work on the flow over obstacles is presented. A model for linear, stationary mountain waves with arbitrary basic flow and two-dimensional topography is described in detail. The option of a nonlinear lower boundary condition is included. The wave drag is computed by three methods and the complete flow field is obtained. The sensitivity of the solutions to small changes of the upstream flow is demonstrated as a critical factor limiting the applicability of the model. The strong downslope wind storms of the Boulder area are briefly discussed in the general context of foehn phenomena. Computations indicate that resonance lee waves do not seem to be part of the mechanism of these winds.
Author

N72-11511# Advisory Group for Aerospace Research and Development, Paris (France).
**A SUMMARY OF ATMOSPHERIC TURBULENCE RECORDED BY NATO AIRCRAFT**
Cyril G. Peckham (Technology, Inc., Dayton, Ohio) Sep. 1971 133 p refs
(Contract AGARD-OTAN SMP 67-68)
(AGARD-R-586-71; UDC-551.551.5) Avail: NTIS

A summary and analysis of flight-measured cumulative acceleration distributions due to atmospheric turbulence are presented. Data from 37 different aircraft was processed. A description of the recording systems and the methods of data processing is given. The power spectral density methods to derive gust velocities is detailed.
Author

N72-11512# Bureau of Meteorology, Melbourne (Australia).
**TROPICAL CYCLONES IN THE NORTHERN AUSTRALIAN REGIONS: 1968-1969 SEASON**
[1971] 59 p
Avail: NTIS

The case histories of the tropical storms that occurred during the 1968-1969 season in the northern Australian Regions are presented. The development, winds, rain, weather satellite observations, and damage for each storm are described. F.O.S.

N72-11513# Institut Royal Meteorologique de Belgique, Brussels.
**CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Aug. 1971 [OBSERVATIONS CLIMATOLOGIQUES BULLETIN MENSUEL, AOUT 1971]**
1971 16 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters observed at different Belgian weather stations during August 1971 are given. ESRO

N72-11514# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
**SOURCES OF TRACE ELEMENTS IN AEROSOLS: AN APPROACH TO CLEAN AIR**
Kenneth A. Rahn May 1971 309 p refs
(Contract AT(11-1)-1705; ORA Proj. 089030)
(COO-1705-9) Avail: NTIS HC $6.00/MF $0.95

The impact of distant (anthropogenic) aerosol sources on the trace element composition of surface air in remote regions of North America was assessed. An optimized nondestructive neutron activation analytical technique was developed for determination of some 30 trace elements and was tested with three pilot studies. These studies, one of the areawide concentration variations and two of diurnal variations, also served to document some features of typical source areas. Final sampling took place at seven locations, ranging from lower Michigan to Northwest Canada. Author NSA

N72-11515# Sandia Corp., Albuquerque, N.Mex. Experimental Atomic and Molecular Research Div.
**VAPOR TRAIL EXPERIMENTS OVER KAUAI, HAWAII AND TONOPAH, NEVADA**
Lawrence B. Smith Jul. 1971 78 p refs Sponsored by AEC
(SC-RR-710008) Avail: NTIS

From June 1962 to June 1967, 49 rocket experiments were conducted during which chemical trails were ejected at altitudes above 80 km. Descriptions of the rocket systems, camera stations, and data reduction are given. Analysis of wind observations and comparison with results at other locations are provided. Included in the analysis is a study of a series of four observations taken during a 6-hour interval. The study shows a downward phase progression during the night and a clockwise rotation of the wind vector with altitude. These characteristics strongly corroborate similar results obtained from a sequence of four observations at Eglin Air Force Base, Florida. In both series the motions suggest the strong influence of a semidiurnal wave. Author (NSA)

N72-11516# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
**SYNOPTIKAL OBSERVATIONS Monthly Bulletin, Nov. 1969 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, NOVEMBRE 1969]**
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in November 1969 are presented. ESRO

N72-11517# Institut Royal Meteorologique de Belgique, Brussels.
**CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Sep. 1971 [OBSERVATIONS CLIMATOLOGIQUES BULLETIN MENSUEL, SEPTEMBRE 1971]**
1971 16 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters observed at different Belgian weather stations during September 1971 are given. ESRO

N72-11518# Illinois State Water Survey, Urbana.
**HEAVY RAIN, HAIL, AND TORNADOES ON 15 MAY 1968**
Stanley A. Changnon, Jr. and John W. Wilson 1971 53 p refs
(PB-200104; RI-66) Avail: NTIS CSCL 04B

On 15 May 1968, a severe storm combining heavy rains, tornadoes, and extensive hail occurred and maximized over a 1765-square-mile dense raingage-hailpad and hail observer network in central Illinois. In a 14-hour period, the network area had 4 major rain systems which included 19 thunderstorms and point rainfalls exceeding 10 inches, 113 hailstreaks with hail over 1664 square miles, and 6 tornadoes. The coincidence of severe weather over a large mesonetwork allowed study of the time-area surface structure of the four storm systems over a larger area and in greater detail than heretofore possible. Author (GRA)

N72-11519# National Oceanic and Atmospheric Administration, Rockville, Md. Weather Modification Div.
**HURRICANE MODIFICATION RESEARCH (PROJECT STORMFURY) Final Environmental Impact Statement**
8 Jul. 1971 20 p ref
(PB-201257F) Avail: NTIS CSCL 04B

Project STORMFURY is a collaborative effort to control hurricanes. The approach to be used in the field experiments involves seeding the clouds surrounding the eye of a mature hurricane with silver iodide crystals to release the latent heat of fusion. Approximately 200 cannisters of pyrotechnic generators are released at an altitude of about 33,000 feet on a line extending radially outward from the storm center and are distributed over 20 miles. Each generator produces 190 grams of silver iodide. Eligible areas for experimentation which have been authorized by the President's Science Advisor and the Department of State, are the Gulf of Mexico, the Caribbean Sea, and the southwestern North Atlantic region. There is no evidence at this time that any adverse effects have occurred or may be expected to occur as a result of these experiments. There is only a remote possibility that seeding will cause a hurricane to intensify or alter its direction of movement. GRA

N72-11520# North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
**ORGANIC MATTER IN MARITIME LIGHT SCATTERING AEROSOLS Final Report**
Lyman A. Ripperton and Harvey E. Jeffries Mar. 1971 92 p refs
(Contract N62306-69-C-0383)
(AD-724795; ESE-Pub-261; NWRF-A2-0471-160) Avail: NTIS CSCL 04/2

Samples of maritime light-scattering aerosols taken at sea in the vicinity of the Virgin Islands in April, July and September of 1970 proved to contain 35% organic material, showed little response to changes in humidity, and gave evidence of containing the organic fraction of the aerosol as a protective coating on the rest of the particulate material. There was a significant difference in the data taken in the different months which may indicate a seasonal difference. Author (GRA)

N72-11521# Environmental Technical Applications Center (Air Force), Washington, D.C.
**PRELIMINARY VERIFICATION OF AFGWC BOUNDARY LAYER AND MACROSCALE CLOUD FORECASTING MODELS**
John W. Diericks Jun. 1971 18 p
(AD-725738; USAFETAC-TN-71-5) Avail: NTIS CSCL 04/2

The report gives the results of a limited verification program of temperature and dew-point forecasts from the AFGWC Boundary-Layer (BLM) and Macroscale Cloud-Forecasting Models

using six locations within the United States. The guidance in this report is necessarily broad because of problems encountered in gathering and processing large data samples. Improvement over persistence forecasts shows the BLM possesses considerable skill east of the Rockies but little or no skill along the western boundary and in the mountainous areas. Author (GRA)

N72-11522# Wyoming Univ., Laramie. Natural Resources Research Inst.
**EVALUATION OF CLOUD SEEDING IN AN OUTDOOR LABORATORY Final Report**
1 Nov. 1970 44 p refs
(Contract N66001-70-C-0639)
(AD-725173) Avail: NTIS CSCL 04/2

Contents: Generation and targeting of artificial ice nuclei; Modification of ice crystal concentrations by artificial ice nuclei; Case studies of orographic cloud response to artificial ice nuclei; Nucleation and growth of cloud particles within the orographic cloud--(Ice crystal genesis by frozen drops, Reactivation of ice crystal nuclei, Nucleation tests on rime ice, Freezing nucleation by AgI complexes). GRA

N72-11523# California Univ., Berkeley. Radio Astronomy Lab.
**REMOTE SENSING OF TROPOSPHERIC TEMPERATURE STRUCTURE BY MEANS OF PASSIVE MICROWAVE RADIOMETRY Final Report, 1 Sep. 1968 - 31 Aug. 1970**
Gayle Miner, Douglas D. Thornton, and William Welch, Jr.
2 Feb. 1971 40 p refs
(Contract F19628-68-C-0022; AF-Proj. 8682)
(AD-725773; AFCRL-71-0119) Avail: NTIS CSCL 04/2

The spectrum of emission from the low-frequency wing of the 5-mm oxygen band as observed at the ground provides data on the temperature profile in the lowest 10 km of the atmosphere. The vertical temperature profile follows from the inversion of the integral equation of radiative transfer. The quality of such an inference depends on (a) the noise in the data, (b) the absolute radiometer calibration errors, (c) the natural resolution of the kernel in the integral equation, and (d) the accuracy with which the gaseous absorption coefficients are known. To investigate the feasibility of this remote sensing, the authors built a scanning radiometer to operate in the interval 50-60 GHz. Observations at 3-5 frequencies were made concomitantly with weather balloon flights at the Oakland, California, weather station. Inversion of the data yielded profiles which agreed with the balloon observed temperatures within 2-3 degrees K RMS. These profiles were more accurate than the daily mean profiles for the station for the particular months. They also exhibited temperature inversions. The limitation in the accuracy resulted from the radiometer noise of 1 degrees -2 degrees K, so that item (a) above dominated. In order to improve the results and to investigate the extent to which items (b), (c), and (d) above would fundamentally limit the technique, development of a new multi-channel radiometer system was begun. Author (GRA)

N72-11524# New York Univ., N.Y. Geophysical Sciences Lab.
**OBJECTIVE ANALYSIS OF SEA-LEVEL WINDS AND PRESSURES DERIVED FROM SIMULATED OBSERVATIONS OF A SATELLITE RADAR-RADIOMETER AND ACTUAL CONVENTIONAL DATA**
Leonard M. Druyan May 1971 82 p refs
(Contract N62306-70-A-0075)
(AD-725805; GSL-TR-71-7) Avail: NTIS CSCL 04/2

A computer based procedure is developed that combines a field of simulated satellite derived wind speeds with a limited amount of conventional surface data so as to recover the surface pressure field and the vector wind field over the North Pacific Ocean. Wind speeds are determined from an objective analysis of high spatial density ship observations in order to simulate the anticipated output of a proposed satellite mounted radar-radiometer system. The conventional surface data consist of sparse observations from ocean-going vessels, observations from several tropical stations and boundary pressures from analyses over coastal areas. The simulated speeds are combined with the conventional network for various spatial distributions of ship data. The average RMS departure of sea-level pressure fields analyzed by deleting from 75% to 94% of the available ship observations from the maximum data analysis is from 3.0 to 4.0 mb. Author (GRA)

N72-11525# Weather Wing (1st), San Francisco, Calif. 96553
**FORECASTING LOW LEVEL TURBULENCE FOR LIGHT AIRCRAFT IN HAWAII Final Report**
Donald L. Best Apr. 1971 6 p
(AD-726107; Rept-1WW-TS-23) Avail: NTIS CSCL 04/2

The proposition is to forecast the intensities of turbulence below 10,000 ft MSL for aircraft weighing less than 10,000 pounds operating along the Hawaiian Island Chain during the 24 hour period beginning at 1200Z (0200 local standard time). The intensities of turbulence to be forecasted are light, moderate, and severe. Light turbulence cases slight, erratic changes in altitude, and/or attitude. Moderate turbulence is similar to light but of greater intensity while the aircraft is still in positive control. Severe turbulence causes large, abrupt changes in altitude and/or attitude and the aircraft may be momentarily out of control. Author (GRA)

# 21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N72-11526*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**MANNED MARS LANDER LAUNCH-TO-RENDEZVOUS ANALYSIS FOR A 1981 VENUS-SWINGBY MISSION**
Nickolas L. Faust and Thomas B. Murtagh Washington Nov. 1971 22 p refs
(NASA-TN-D-6555; MSC-S-282) Avail: NTIS CSCL 22C

A description is given of the return of a manned Mars lander by a launch from the surface of Mars to some intermediate orbit, with subsequent maneuvers to rendezvous with a primary spacecraft (called the orbiter) in a Mars parking orbit. The type of Mars mission used to demonstrate the analytical technique includes a Venus swingby on the Mars-to-Earth portion of the trajectory in order to reduce the total mission velocity requirement. The total velocity requirement for the mission considered (if inplane launches are assumed) is approximately 17,500 ft/sec. Author

N72-11527*# Massachusetts Inst. of Tech., Cambridge.
**DISPLAY RESEARCH COLLISION WARNING SYSTEM Patent Application**
Renwick E. Curry, Lawrence R. Young, Thomas B. Smith, III, and John R. Hatfield, inventors (to NASA) Filed 25 Jun. 1971 15 p
(Grant NGR-22-009-444)
(NASA-Case-HQN-10703; US-Patent-Appl-SN-156724) Avail: NTIS CSCL 17G

An improved head-up display for a pilot warning indicator (PWI) system is discussed. The system includes a plurality of elongated light sources which are attached about the cockpit windshield and side windows. Whenever a target in a sector, which is viewable from the cockpit, is detected by a corresponding detector at least one of the light sources is illuminated. The illuminated light source (or sources) provides an indication of the sector in which the target was detected. The length of the light source (or sources) provides a convenient indication of the sector's bearing boundaries. The novelty of the invention seems to reside in the use of elongated, rather than spot, light sources to indicate to the pilot sector bearing boundaries and thereby speed-up target detection. Author

**N72-11528#** Air Force Cambridge Research Labs., Bedford, Mass.
**RESULTS FROM SIMULATIONS OF CONTINUOUSLY INTEGRATED DOPPLER FOR PRECISE AIRCRAFT POSITIONING**
George Hadgigeorge, Duane C. Brown, and Jerry E. Trotter 25 Apr. 1971 21 p refs
(AF-Proj. 7600)
(AD-725780; AFCRL-71-0252; AFCRL-IP-170) Avail: NTIS CSCL 08/5

The paper reports AFCRL findings concerning precise positioning of aircraft with GEOCEIVERS. The conditions and assumptions made in the simulations are presented along with the associated rigorous error propagation. The assumptions were influenced by AFCRL's previous studies and experience with prototype GEOCEIVER data reductions and by the Navy's description of the production GEOCEIVERS. The error propagation indicates that when a well-designed highly redundant, tracking configuration of GEOCEIVERS of known location is exercised over a wide sweep of geometry, accuracies on the order of 0.1 to 0.3 m (1 sigma) can be expected for the recovery of that portion of the trajectory intercepted by the boundary of the tracking configuration. Author (GRA)

**N72-11529#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**THE EFFECT OF GRAVITY ON A LIQUID-FILLED GYROSCOPE**
William P. DAmico Mar. 1971 22 p refs
(DA Proj. 1T0-61102-A-33-D)
(AD-725571; BRL-MR-2097) Avail: NTIS CSCL 17/7

The effect of gravity as a simple vertical body force was included in the steady state pressure distribution of a rapidly spinning liquid. For the simple case of a completely filled cylinder, the classical liquid-filled gyroscope stability problem was considered. Analysis showed that the liquid eigenfrequencies were identical to the Stewartson case and that a new, but second order, liquid moment term resulted. Author (GRA)

**N72-11530#** Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
**TECHNIQUES FOR GENERATING GUIDANCE SIGNALS FROM BODY-FIXED SENSORS Final Technical Report, 10 Apr. 1969 - 9 Feb. 1971**
L. D. Holland and R. D. Wetherington 9 Feb. 1971 137 p refs
(Contract DAAH01-69-C-1390; GIT Proj. a-1164; DA Proj. 1M262301A204)
(AD-725599; GIT-A-1164-F) Avail: NTIS CSCL 17/7

The feasibility of using a relatively simple guidance technique and a strapdown sensor for guidance of a small tactical missile has been investigated. The principal method investigated was Dynamic Lead Guidance (DLG). Theoretical analyses were carried out to determine workable system parameters, to determine the required sensor characteristics, and to investigate the performance of DLG for sampled data input. Simulation runs were used to examine the dependence of system performance on the sensor characteristics, sampled data operation, cross-feed between channels, gyro gain, and gravity bias. Both constant velocity and maneuvering targets were simulated. Dynamic lead guidance was found to be a practical technique provided a strapdown sensor with the proper characteristics can be developed.
Author (GRA)

## 22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

**N72-11531** National Lending Library for Science and Technology, Boston Spa (England).
**SOME PROBLEMS IN THE DEVELOPMENT OF FUEL ELEMENTS FOR FAST REACTORS**
I. S. Golovnin, Y. K. Bibilashvili, T. S. Menshikova, A. V. Medvedev, and G. V. Kalashnik 1971 7 p Transl. into ENGLISH from At. Energ. (Moscow), v. 30, no. 2, 1971 p 216-221
(NLL-Risley-Tr-2185-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

An approach to the development of economical fast reactor fuel elements is presented. Problems discussed include the following effects on the effective fuel density: thermal stress, porosity of the sintered pellets, and core swelling. A comparison of oxide and carbide fuel elements is included. F.O.S.

**N72-11532** National Lending Library for Science and Technology, Boston Spa (England).
**HIGH-CURRENT TECHNIQUES IN PRESENT-DAY NUCLEAR FUSION RESEARCH AND DEVELOPMENT (PARTS 1 AND 2)**
H. Bertele and J. Mitterauer 28 Jul. 1971 88 p refs Transl. into ENGLISH from Elektrotech. Maschinenbau (W. Berlin), v. 87, 1970 p 139-152; 304-313, and 343-353
(NLL-CTO-752-(9091.9F); NLL-CTO-753-(9091.9F); CR-71-101; CRO-752; CRO-753) Avail: Natl. Lending Library, Boston Spa, Engl.: 9 NLL photocopy coupons

The details of design and principles of nuclear fusion are reviewed. The review covers the generation, heating, and confinement of thermonuclear plasmas. A systematic analysis of the electrical engineering problems encountered, and the specific examples used to illustrate the design and operation of nuclear fusion experiments are given. Particular attention is given to switch gear in high current pulse systems. E.H.W.

**N72-11533** National Lending Library for Science and Technology, Boston Spa (England).
**INVESTIGATION OF WEAR AND FRICTION BETWEEN FUEL ELEMENT BUNDLES AND SPECIAL GRIDS IN SODIUM**
K. Kleefeldt 23 Jul. 1971 13 p Transl. into ENGLISH of German report KFK-1290
(NLL-Risley-Tr-2174-(9091.9F); KFK-1290) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Experiments in sodium are recorded in which the friction between fuel-element bundles and spacing grids is investigated up to temperatures of 680 C. The relative axial movement between fuel rods and grids caused by the different thermal expansions was produced mechanically by an eccentric drive. The frictional forces arising in sodium were between 5 and 30 kp per grid and in air and argon were above these values. For two lattice constructions, a critical frictional force of about 55 - 80 kp and 60 - 80 kp respectively was established above which the grid tends to break because of clamping on repeated lifting movement. Such critical values can be obtained by too small clearances. The increase of clearance because of wear is less than 0.02 mm. It is thus far less than the manufacturing and operational tolerance limits. Diffusion-welding of the contact points in sodium could not be established after a seven-day trial at 600 C in a stationary condition. The advantages and disadvantages of the grid findings selected are discussed.
Author

**N72-11534** National Lending Library for Science and Technology, Boston Spa (England).
**EQUIPMENT AND DISSOLUTION PROCEDURES FOR RELEASE OF FISSION GASES FROM NUCLEAR FUEL**
Siegfried Kiessling and Markus Stoeppler 7 Sep. 1971 16 p refs Transl. into ENGLISH of German report Juel-627-RB
(NLL-LB/G/2997-(9091.9F); Jul-627-RB) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Two versions of a remote handling quartz or duran apparatus for the dissolution of irradiated nuclear fuel samples

consisting of UO2 pellets and coated particles are described. With the aid of specially purified helium the fission gases are transported to and adsorbed at a cooled filter. This is followed by determination by gamma spectrometric or mass spectrometric measurements. Some acid mixtures for the dissolution of the materials described are compared and the results are discussed. Author

N72-11535*# Aerojet Nuclear Systems Co., Azusa, Calif.
**SNAP-8 POWER CONVERSION SYSTEM DESIGN REVIEW**
L. P. Lopez Jun. 1970 261 p
(Contract NAS3-13458)
(NASA-CR-72945; AGC-4017) Avail: NTIS CSCL 18N

The conceptual design of the SNAP-8 electrical generating system configurations are reviewed including the evolution of the PCS configuration, and the current concepts. The reliabilities of two alternative PCS-G heat rejection loop configurations with two radiator design concepts are also reviewed. A computer program for calculating system pressure loss using multiple-loop flow analysis is included. F.O.S.

N72-11536*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MOLYBDENUM-U02 CERMENT IRRADIATION AT 1145 K**
G. McDonald Oct. 1971 15 p refs Presented at the Winter Meeting of the Am. Nucl. Soc., Miami Beach, Fla., 17-21 Oct. 1971
(NASA-TM-X-67954; E-6650) Avail: NTIS CSCL 18J

Two molybdenum-UO2 cermet fuel pins were fission heated in a helium-cooled loop at a temperature of 1145 K and to a total burnup of 5.3 % of the U-235. After irradiation the fuel pins were measured to check dimensional stability, punctured at the plenums to determine fission gas release, and examined metallographically to determine the effect of irradiation. Burnup was determined in several sections of the fuel pin. The results of the postirradiation examination indicated: (1) There was no visible change in the fuel pins on irradiation under the above conditions. (2) The maximum swelling of the fuel pins was less than 1%. (3) There was no migration of UO2 and no visible interaction between the molybdenum and the UO2. (4) Approximately 12% of the fission gas formed was released from the cermet cone into the gas plenum. Author

N72-11537# Battelle Memorial Inst., Columbus, Ohio.
**PROGRESS ON LMFBR CLADDING, STRUCTURAL, AND COMPONENT MATERIALS STUDIES Quarterly Report, Jan. - Mar. 1971**
Donald L. Keller Apr. 1971 34 p refs
(Contract W-7405-eng-92)
(BMI-1903) Avail: NTIS

Activities in programs directed toward developing mechanical property design data and results of long term studies directed toward the elucidation of the effects of irradiation on cladding and structural alloys are reported. Low cycle strain controlled fatigue tests were conducted on Type 304 stainless steel. Fifteen specimens were tested under continuous cycling conditions (no hold times) at 1000 and 1200 F. Five additional specimens were tested at 1000 F under tension hold times ranging from 10 to 300 min. Results indicate that the tension hold times at 1000 F produce significant reductions in cyclic fatigue life. Creep rupture tests have been initiated on Incoloy 800 at 1400 F to complement the fatigue data already obtained on this material. In addition, a least squares regression approach has been used to perform a Larson-Miller parameter analysis of Incoloy 800 creep data in the literature. Tensile properties of stainless steel specimens irradiated in the EBR-II at 400 and 650 C were determined at room temperature to 750 C. Author (NSA)

N72-11538# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**CORROSION IN POLYTHERMAL LOOP SYSTEMS. 2: A SOLID-STATE DIFFUSION MECHANISM WITH AND WITHOUT LIQUID FILM EFFECTS**
R. B. Evans, III, J. W. Koger, and J. H. Devan Jun. 1971 74 p refs
(Contract W-7405-eng-26)
(ORNL-4575-Vol-2; UC-25-Vol-2) Avail: NTIS

Several mathematical descriptions were developed to explain selective transport of corrosion labile constituents of nickel based alloys in reactor systems. Special attention is given to cases in which solid state diffusion in the alloy, as influenced by coolant characteristics and composition, dominates the corrosion mechanism. Equations are derived for both transient and steady state cases. Applicability of the derived equations is demonstrated by comparison of predicted values with experimental results for two distinctly different systems. The first involves hot-to-cold-zone transfer of nickel in Inconel 600 pumped loops circulating liquid sodium. Comparisons revealed that actual corrosion is much higher than predicted by the equations; this suggests that the true corrosion reaction overrides a slow solid state diffusion process. The second system considered is transfer of chromium in Hastelloy N loops with molten salt flow induced by thermal convection. The success of the early Cr-51 tracer experiments suggests that the solid state diffusion mechanism does apply to certain molten salty systems. Author (NSA)

N72-11539# WADCO Corp., Richland, Wash.
**THE EFFECT OF STRAIN RATE ON THE MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEELS Interim Report**
J. M. Steichen and M. M. Paxton May 1971 50 p refs
(Contract AT(45-1)-2170)
(HEDL-TME-71-56) Avail: NTIS

The effect of strain rate on the mechanical properties of unirradiated solution-annealed and slightly cold-worked Type 304 stainless steel for the temperatures (to 1600 F) and rates (to 6 x 1,000 in./in./min) was determined. Although the strain rate effects are complex, in general, the ultimate stress, uniform elongation, deformation energy to plastic instability, and total deformation energy increase with increasing strain rate to 1000 F and higher. Effects are not pronounced at the lower temperatures. The 0.2% yield stress and total elongation appear to be only slightly strain rate dependent. It is concluded from the initial high strain rate data that mechanical properties of austenitic stainless steels can be significantly affected by strain rate and that where safety analyses and fuel performance characteristics are sensitive to these effects the material properties for the deformation rates and material conditions being considered should be used. Author (NSA)

N72-11540# California Univ., Livermore. Lawrence Radiation Lab.
**CONTROLLED FUSION POWER REACTORS**
Gustav A. Carlson 17 May 1971 26 p
(UCRL-73196) Avail: NTIS

The relative importance of thermal conversion and direct conversion for two types of fusion reactors is described. The conversion systems are described in some detail. NSA

N72-11541# Atomics International, Canoga Park, Calif.
**FUELS, MATERIALS, AND COOLANT CHEMISTRY PROGRAMS Quarterly Technical Progress Report, Jan. - Mar. 1971**
30 Apr. 1971 63 p refs
(Contract AT(04-3)-824)
(AI-AEC-12993) Avail: NTIS

Results of testing of FFTF vapor traps, freeze vents, and filters are reported. In other work, an analytical model of Na oxidation rates was developed. Results of continued stress-rupture tests on Types 304 and 316 stainless steel in Na at high temperatures are presented along with results of irradiation testing of Type 316 stainless steel. Work directed toward determining elements and compounds found in reactor materials that produce helium during exposure to fast neutron fluxes is described. Author

N72-11542# Argonne National Lab., Ill. Chemistry Engineering Div.
**[REACTOR TECHNOLOGY AND CHEMISTRY FOR THE LMFBR. CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, JANUARY - DECEMBER 1970]**
Dec. 1970 157 p refs
(Contract W-31-109-eng-38)
(ANL-7750) Avail: NTIS

Investigations were continued in the areas of fuel-cycle technology, sodium technology materials properties, analytical and reactor chemistry, liquid-metal and molten-salt studies, energy conversion, and fluidized-bed combustion of fossil fuels. For reprocessing LMFBR irradiated fuel, a head-end process for decladding the fuel in liquid metal, a process for converting recovered plutonium and uranium nitrate solutions to oxides, and a centrifugal contactor suitable for high plutonium content are being developed. Analytical procedures adaptable to in-line use in the fabrication of LMFBR fuel are also being studied. In the sodium technology program, major emphasis is being placed on the measurement of sodium quality by chemical analyses and on-line monitors. An effort is also being made to develop failed-fuel-element detectors. Materials and chemistry studies are concerned with various aspects of the behavior of materials in fast reactors. Author (NSA)

N72-11543# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
**SEPARATION OF VANDIUM ON UO2 SPHERES FROM THE GASEOUS PHASE**
H. Schneider and D. Schoenwald [1971] 21 p refs Transl. into ENGLISH of German report KFK-1292 Sponsored by US-EURATOM Fast Reactor exchange Program
(EURFNR-859; KFK-1292; DR-1868) Avail: NTIS

A method is described to provide for fluidized bed coating of spherical UO2 with metallic vanadium having a chlorine content < 0.01%. By reduction of VCl4 above 950 C in the presence of hydrogen, up to 45 vol.% of vanadium was vapor deposited on batches of 30 to 50 g of UO2 spheres. The coatings had bright surfaces, were of good quality, and were dense and uniform. The coated particles were used for fabrication of UO2 V cermets of ideal structure and could be packed satisfactorily by isostatic hot compaction. Author (NSA)

N72-11544# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
**FISSION GAS RE-SOLUTION RATES Quarterly Report, 1 Jan. - 31 Mar. 1971**
M. O. Marlowe Apr. 1971 7 p refs
(Contract AT(04-3)-189)
(GEAP-12189; QR-3) Avail: NTIS

Progress in experimental programs and studies to determine the re-solution rates of fission gases in oxide nuclear fuels under irradiation is described. An abrasive blasting technique was developed out-of-pile for thinning of the disk specimens to approximately 10 micrometers. Accurate determination of the current radioactivity of the specimens indicated that thinning before handling will be required. A copy of the LIFE computer code for fuel performance prediction was received and will be used for development of a compatible subroutine for incorporation of the results obtained into models. Author (NSA)

N72-11545# WADCO Corp., Richland, Wash.
**DISSOLUTION OF UNIRRADIATED MECHANICALLY BLENDED MIXED OXIDE FAST REACTOR FUEL**
R. E. Lerch and G. F. Schiefelbein (Battell-Northwest) Apr. 1971 22 p refs Presented at the 17th Ann. Meeting of the Am. Nucl. Soc., Boston, 13-17 Jun. 1971
(Contracts AT(45-1)-2170; AT(45-1)-1830)
(HEDL-SA-131; Conf-710606-1) Avail: NTIS

A statistical, fractional fractorial experiment was performed to determine the effect of six fuel fabrication variables on the dissolubility of unirradiated, mechanically blended PuO2-UO2 fuels. The six fabrication variables were source of PuO2, PuO2 content, sintering temperature, sintering time, rate of temperature rise during sintering, and pellet pressing pressure. All six fabrication variables had some effect on pellet dissolubility with source of PuO2, PuO2 content, and sintering temperature having major effects. Author (NSA)

N72-11546# Oak Ridge National Lab., Tenn. Reactor Div.
**THE BLASCON: AN EXPLODING PELLET FUSION REACTOR**
A. P. Fraas Jul. 1971 45 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3231) Avail: NTIS

A fusion reaction can be initiated by directing an intense laser beam with a short pulse duration at a pellet of a frozen deuterium-tritium mixture. A study of the application of this approach to a series of conceptual designs has yielded some surprisingly attractive systems. Analyses and tests indicate that the explosion can be contained in a pressure vessel, and that, if pellets can be exploded at about 10 sec intervals, a reactor and pressure vessel assembly can be obtained at a modest unit cost for central stations or ship power plants having outputs as low as 100 MW(t). A reactor of this type would require no large magnets; activation of the structure would be negligible thus easing afterheat and hazards problems; and the problems of fast neutron damage to the reactor structure would be avoided. The exploding-pellet concept might also be applied to give a spacecraft propulsion system that might reduce the propellant weight requirements for an Earth-Mars-Earth mission to about 10% of that for a Rover-type nuclear rocket. Author (NSA)

N72-11547# Douglas United Nuclear, Inc., Richland, Wash.
**ALTERNATE PROCEDURES FOR THE EXTENDED LAYUP OF N REACTOR**
W. D. Bainard, W. K. Kratzer, and A. P. Larrick [1971] 10 p refs
(Contract AT(45-1)-1857)
(DUN-7541) Avail: NTIS

Different layup procedures, estimated technical problems, relative cost, and long term support and surveillance requirements are outlined. The methods are listed in decreasing order of reliability. (1) Wet layup involves maintaining a passivating solution in each system; it is by far the most effective in preventing corrosion, but requires frequent operation and analysis. (2) Dry layup by passivating the surfaces with a hot, circulating nitrite phosphate solution, thorough drying, and continued protection with vapor phase inhibitor or inert gas blanket results in efforts and costs comparable to those for decontamination. (3) Dry layup by drying the surface completely and maintaining a nitrogen atmosphere requires engineering and installation costs with weekly surveillance. (4) Dry layup without additional protection will provide short term protection from gross corrosion. (5) Draining the systems and closing them will cause immediate and extensive corrosion. Author

N72-11548# Oak Ridge National Lab., Tenn.
**ORNL ISOTOPIC POWER FUELS Quarterly Report, period ending 31 Mar. 1971**
Eugene Lamb Jun. 1971 24 p refs
(Contract W-7405-eng-26)
(ORNL-4692) Avail: NTIS

The series of tests on CM2(244)O3 solubility was completed, and the results indicate a low solubility in both distilled and sea water. A new series of tests to identify the dissolution reaction(s) will be started. A process for manufacturing microspheres using ion-exchange resins is being investigated. Cermet fuel forms of 20 and 40 vol % oxide fuel contents are being developed with ThO2 as a stand-in for CM2(244)O3. Parametric studies of both cold pressing and sintering, and hot pressing fabrication processes are underway. The curium source test completed one year of operation. Thulium sesquioxide powders originally introduced into a Knudsen cell to obtain weight-loss data sintered into a pellet after two 48-hr runs. Author NSA

N72-11549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**HEAT EXCHANGE AND HYDROMECHANICS OF DISPERSED THROUGH FLOWS (SELECTED PORTIONS)**
Z. R. Grobis 26 Jan. 1971 16 p refs Transl. into ENGLISH from the book "Teploobmen i Gidromekhan. Dispersnykh Skvoznykh Potokov" Moscow, 1970 p 390-398, p 402-405, p 408-409, p 414-419
(AF Proj. FTD-6020401)
(AD-724976; FTD-MT-24-309-70; Task-DIA-T70-02-018) Avail: NTIS CSCL 18/10

The selected portion of a larger work deals with two types of nuclear reactors with dispersed through flows - those with an active solid component of the dispersed heat-transfer agent, and those with an inert component. Results of a 1957 study of the OTIL on the use of particles of artificial graphite as the dispersed component are discussed. The compatibility of the graphite with other properties and the high quality of its physical properties are stressed. A gas-graphite heat-transfer agent is seen as a very promising coolant for high-temperature nuclear reactors, and the prospect of gas-graphite flows also as a new working body in single-circuit nuclear devices is emphasized. GRA

N72-11550# Oak Ridge National Lab., Tenn.
**INDEX TO NUCLEAR SAFETY. A TECHNICAL PROGRESS REVIEW BY CHRONOLOGY, PERMUTED TITLE, AND AUTHOR, VOLUME 1, NUMBER 1 THROUGH VOLUME 11, NUMBER 6**
J. P. Blakely and Ann Klein Jul. 1971 112 p refs
(Contract W-7405-eng-26)
(ORNL-NSIC-86) Avail: NTIS

A KWIC index is presented for articles appearing in the journal Nuclear Safety. Abstracts are included for all articles, beginning with Volume 7. D.L.G.

# 23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N72-11551 National Lending Library for Science and Technology, Boston Spa (England).
**CALCULATION OF THE DIELECTRIC CONSTANT OF WATER IN THE SUBMILLIMETER WAVE BAND [RASCHET DIELECTRICHESKOI PRONITSAEMOSTI VODY V SUBMILLIMETROM DIAPAZONE RADIOVOLN]**
Yu. I. Malyshenko and I. Kh Vakser Sep. 1971 11 p refs Transl. into ENGLISH from Ukr. Fiz. Zhi (Kiev), v. 15, no. 9, 1970 p 1496-1503
(NLL-RTS-6639) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.10 or 4 NLL photocopy coupons

It is shown experimentally that semi-empirical Debye equations can be used to calculate the dielectric constant of water in the U.H.F. wave band as far as the 0.8 mm wavelength, and method is proposed for calculating frequency and temperature dependencies of the dielectric constant of water on shorter waves. Complex dielectric constants are calculated and also the coefficient of the refraction of water in the whole submillimeter wave band for a wide interval of temperatures. The calculations agree with existing experimental data for the submillimeter wave band. Author

N72-11552 National Lending Library for Science and Technology, Boston Spa (England).
**NOISE PROBLEMS IN LARGE CLOSED CIRCUIT COOLING PLANT**
A. Boehm, D. Bublitz, and M. Hubert 19 Aug. 1971 18 p Transl. into ENGLISH from Emissionen, Apr. 1970 p 33-41
(NLL-CE-Trans-5694-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A survey is provided of the noise behaviour of the most important types of cooling tower, in terms of frequency spectra. The fractions of noise radiated by both the intake and the diffusor at any given target point were investigated by means of measurements on models in an anechoic chamber. The required reductions of noise level were determined. Steps that can be taken to bring about these reductions by screening, installation of sound absorbers, or impact attenuation are enumerated. Author

N72-11553 National Lending Library for Science and Technology, Boston Spa (England).
**ALTERATION IN THE MAGNETIC AND ELECTRICAL PROPERTIES OF CERTAIN FERROMAGNETIC MATERIALS DURING DEFORMATION FOLLOWED BY ANNEALING [IZMENENIE MAGNITNYKH I ELEKTRICHESKIKH SVOISTV NEKOTORYKH FERROMAGNITNYKH MATERIALOV V PROITSESSE DEFORMATSII I POSLEDUYUSHCHEGO OTZHIGA]**
M. N. Bodyako, S. A. Astapchik, and V. A. Kryukov Oct. 1971 11 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Tekh. Navuk (Minsk), v. 3, 1970 p 23-29
(NLL-RTS-6584) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

The effect of deformation of ferromagnetic materials followed by annealing on the electrical and magnetic properties of the materials is discussed. It is determined that these properties depend basically on distortions of the crystal lattice, the shape and dimensions of the grains, the presence of particles of other phases, the degree of dispersion, and different types of inclusions. Cold plastic deformation causes shears in the grains and distorts the three-dimensional lattice. Annealing relieves the strains and restores the magnetic and electrical properties which were altered by the distortion. Author

N72-11554 Washington Univ., St. Louis, Mo.
**AN INVESTIGATION OF THE VALIDITY OF KIRCHHOFF'S LAW FOR FREELY RADIATING METALLIC SURFACES Ph.D. Thesis**
Thaddeus Claude Grimm 1970 166 p
Avail: Univ. Microfilms Order No. 70-18947

The validity of Kirchhoff's law for freely radiating metallic surfaces was studied. An emissometer was constructed that was capable of accurately measuring the total hemispherical emittance of optically smooth metals in both ice-water and liquid nitrogen cooled surroundings. The total hemispherical emittance of Parsons optical black lacquer, aluminum pigmented silicone base paint, polished copper, platinum, and tantalum, and electroplated and vapor plated gold on polished copper were measured. Based upon the experimental results for optically smooth metallic surfaces, it is concluded that Kirchhoff's law is valid within the accuracy of the experimental technique, i.e., + or - 2%, for freely radiating metallic surfaces. Dissert. Abstr.

N72-11555 Carnegie-Mellon Univ., Pittsburgh, Pa.
**THE CONDUCTING BOUNDARY RING DISCHARGE Ph.D. Thesis**
Howard Frederick Slater, Jr. 1969 105 p
Avail: Univ. Microfilms Order No. 70-17146

A conducting boundary device in a uniform magnetic field was used to collect data. The device was composed of a circular cylinder with end disks and a central source of ionization. The structure enabled the total current as well as the current density distribution to be measured. Particle density distribution can be determined from the current density distribution. A general diffusion equation was derived to explain the observed change of the distribution of end current density. The self-maintaining ring discharge is a type of glow discharge between the cylinder and the end disks. Discharge dependence on wall material, gas, end disk potential, and the magnetic field is explained. Dissert. Abstr.

N72-11556 Stanford Univ., Calif.
**AN EXPERIMENTAL STUDY OF AN INFRARED MODULATOR AND IMAGE CONVERTER TUBE Ph.D. Thesis**
Jens Aage Tellefsen 1970 199 p
Avail: Univ. Microfilms Order No. 70-18487

The main objectives of the research program were (1) to investigate theoretically those aspects of electron-beam-generated free-carrier optical effects considered relevant to the possibility of constructing infrared modulation and imaging devices, (2) to verify experimentally some of tye major predictions of the theoretical study, (3) to design, construct, and to operate an infrared imaging system based on a Filterscan type concept proposed by Hayami and Siegman, and (4) to investigate the characteristics of this type of imaging system with particular emphasis on coherent illumination. An outline of the pertinent theoretical models necessary for an understanding of the optical progerties of electron beam generated free carriers is presented, with particular emphasis on the problems of very high carrier densities. The bombardment process is analyzed, yielding a suitable expression for the electron hole pair generation rate.
Dissert. Abstr.

N72-11557# Academy of Sciences (USSR), Moscow. Inst. of Metallophysics.
**INFLUENCE OF THE KAPPA PRIME TO ALPHA SUB M TRANSITION IN THE RESTORATION OF A MARTENSITIC TRANSFORMATION UPON HEATING**
L. I. Lysak, L. O. Andrushchik, and N. A. Storchak 1970 20 p refs In RUSSIAN
Avail: NTIS

Experimental results are presented for dilatometric and magnetometric studies of phase transformations during sudden freezing in liquid nitrogen and subsequent heating of manganese and rhenium steels, as well as iron-nickel alloys. It is proposed that a decrease in atomic volume during transformation leads to partial relaxation of internal pressures at very low temperatures. This furthers the restoration of a martensitic transformation (by the formation of isothermal martensite). Transl. by K.P.D.

N72-11558# Instituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**LIGHT INTENSITY MONITOR DEVICE FOR PERFORMING OPTICAL MODULATION SPECTROSCOPY [UN MONITOR DI INTENSITA LUMINOSA PER MISURE DI SPETTROSCOPIA OTTICA MODULATA]**
C. Felici and C. Ranghiasci 22 Mar. 1971 10 p refs In ITALIAN; ENGLISH summary
(ISS-71/3) Avail: NTIS

A light intensity monitor for use in spectroscopic measurements of optical modulation in solids is described. A block diagram and electrical schematics of the monitor are included. Author

N72-11559# Instituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD JANUARY - APRIL 1969 A Synopsis [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO - APRILE 1969]**
6 Oct. 1969 48 p Mostly in ITALIAN; partly in ENGLISH
(ISS-69/39) Avail: NTIS

Summaries of the lectures presented at the physics laboratory for the period January to April 1969 are reported. Topics include: use of CERN accumulation rings for studying protof-proton collisions, measuring interplanetary plasmas by artificial satellite, electromagnetic interactions, using magnetic resonance in liquid phases, and Boolean algebra and its applications to digital electronics. Transl. by F.O.S.

N72-11560# Instituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**A COMPUTER PROGRAM FOR THE EVALUATION OF THE OPTICAL CONSTANTS OF SOLIDS, VIA THE DISPERSION RELATIONS [UN PROGRAMMA PER IL CALCOLO DELLE COSTANTI OTTICHE DI UN SOLIDO MEDIANTE LE RELAZIONI DI DISPERSIONE]**
A. Verdecchia 30 Jan. 1971 38 p refs In ITALIAN
(ISS-71/1) Avail: NTIS

A complete program is presented for the evaluation of the optical constants of solids, via the application of the Kramers-Kronig dispersion relations to the experimental reflectivity data obtained at normal incidence. The program output gives the real and imaginary parts of the refractive index and of the dielectric constant, the energy-loss function, the effective static dielectric constant, and the effective number of free electrons contributing to the optical transitions. Author

N72-11561# Hamburg Univ. (West Germany).
**THE OPTICAL PROPERTIES OF SOLID NEON AND ARGON IN THE PHOTON ENERGY REGION BETWEEN 10eV AND 500 eV Ph.D. Thesis [DIE OPTISCHEN EIGENSCHAFTEN VON FESTEM NEON UND ARGON IM PHOTONENERGIEBEREICH ZWISCHEN 10 eV UND 500 eV]**
Gerd Keitel 1970 79 p refs In GERMAN
Avail: NTIS

Optical properties and band structures of solid neon and argon are studied for the 10 eV to 500 eV photon energy region. Optical measurements show that sharply defined structures develop during beginning excitation of a new electron shell; this effect is attributed partly to excitons and partly to interband transformations. Line series developing in the fundamental absorption region before interband transformations commence are interpreted as Wannier exciton series. Excitation of the next inner shell electrons in solid Ar and Ne also produces excitons. These excitons surface close to the corresponding gas lines and also possess definite autoionization profiles. Studies on Ne-Ar mixtures prove that Wannier excitons of the second class, forbidden excitons, are present in solid Ne and Ar excitations.
Transl. by G.G.

N72-11562# Electrotechnical Lab., Tokyo (Japan).
**TABLES OF BLACKBODY RADIATION FUNCTIONS FOR THE ULTRAVIOLET, VISIBLE AND INFRARED REGIONS**
Mamoru Suzuki, Mitsuhiro Habu, and Takehiko Nagasaka Dec. 1970 147 p refs In JAPANESE; ENGLISH summary
(RR-715) Avail: NTIS

Black body radiation is used for establishing radiation standards and calculating Planck's law for photometric, colorimetric, and thermometric measurements. Spectral radiant power standards are tabulated at specified temperatures and wavelengths. The number of photons per second in the monochromatic radiant flux of 1 W was a function of lambda, photometric characteristics of a black body as a function of T, and the relation between wavelength and wave number are included. J.A.M.

N72-11563*# Translation Consultants, Ltd., Arlington, Va.
**ACOUSTIC ROUGHNESS AND FLUCTUATION STRENGTH [UEBER AKUSTISCHE RAUHIGKEIT UND SCHWANKUNGS STAERKE]**
E. Terhardt Washington NASA Nov. 1971 21 p refs Transl. into ENGLISH from Acustica (Stuttgart), v. 20, 1968 p 215-224
(Contract NASw-2038)
(NASA-TT-F-13941) Avail: NTIS CSCL 20A

Measurements were carried out with four subjects to determine the laws describing the dependence of the perceived acoustic roughness and fluctuation strength on the parameters of an amplitude modulated pure tone (modulation factor, level, modulation and carrier frequency). It is shown that fluctuation strength and roughness are proportional to the square of the modulation factor and double for any 20 dB increase in level. Furthermore, the influence of modulation and carrier frequency yield interesting indications to the frequency selection in temporally fluctuating stimuli. Author

N72-11564# Joint Publications Research Service, Washington, D.C.
**INTERFERENCE EFFECTS IN OPPOSING-ROD (ELECTRODE) CONVERTERS OF ULTRASONIC SURFACE WAVES**
A. V. Kovalev and I. B. Yakovkin 1 Nov. 1971 4 p refs Transl. into ENGLISH from Radiotekhn. i Electron. (Moscow), no. 8, 1971 p 1521-1523
(JPRS-54366; UDC-534-232-8) Avail: NTIS

A method for converting electromagnetic energy into ultrasonic surface waves with a counter-rod type converter is presented. A theoretical assessment of the frequency characteristics of the instrument as a function of electrode configuration is reported. Experiments aimed at determining the characteristics of various forms of the instrument are explained. Author

N72-11565# Toronto Univ. (Ontario). Dept. of Electrical Engineering.
**ELECTROMAGNETIC COUPLING THROUGH SMALL APERTURES**
N. A. McDonald May 1971 162 p refs
(Grant DRB-G-5540-02)
(RR-45) Avail: NTIS

A method is presented for evaluating the coupling between two identical resonant cavities coupled by a small aperture in a plane common wall of arbitrary thickness. The coupling is related to the frequencies of the symmetric and asymmetric models of oscillation of the coupled cavity structure and a variational techniques is used to determine those frequencies. The method is applied to circular and rectangular apertures, and it is shown that the coupling is separable into electric and magnetic terms. Experimental results obtained with circular and square apertures are presented and are consistent with the theory. Author

N72-11566# Technische Hogeschool, Delft (Netherlands).
**SOME MEASUREMENTS IN LIQUID HELIUM FOUR Ph.D. Thesis**
Jacob Meyer Goldschvartz 7 Jul. 1971 184 p refs
Avail: NTIS

Liquid helium is a very peculiar and conspicuous substance. It represents a dramatic manifestation of nature revealed by science. Particularly this is true for the phase of liquid helium four, (He-4) called liquid helium two with its superfluid component which has no entropy, no viscosity, presents no friction and exhibits a notable zero point energy. A fundamental feature of the superfluid liquid helium four is that it is a quantum liquid. Liquid helium three is a quantum liquid too although it does not present the phenomenon of superfluidity. Author

N72-11567*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPROVED HELIUM REFRIGERATOR AND METHOD FOR DECONTAMINATING THE REFRIGERATOR Patent Application**
Ervin R. Wiebe, inventor (to NASA) Filed 5 Feb. 1971 16 p
(Contract NAS7-100)
(NASA-Case-NPO-10634; US-Patent-Appl-SN-112999) Avail: NTIS CSCL 20L

For use in a multi-stage refrigeration system an improved heat exchanger with hermetically sealed housing and chambers defining a pair of concentrically related counter-current passages extending therethrough is reported. A particular feature is a decontaminating system which includes a circuit pneumatically coupled with a given heat exchanger and adapted to vent and flush the heat exchanger with a gas delivered under pressure and at ambient temperature so that frozen contaminants operatively are melted and simultaneously expelled from the system. NASA

N72-11568*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**METHOD AND APPARATUS FOR ELIMINATING COHERENT NOISE IN A COHERENT ENERGY IMAGING SYSTEM WITHOUT DESTROYING SPATIAL COHERENCE Patent Application**
Arnold R. Shulman, inventor (to NASA) Filed 5 Mar. 1971 20 p
(NASA-Case-GSC-11133-1; US-Patent-Appl-SN-121328) Avail: NTIS CSCL 20F

A method and apparatus for substantially eliminating noise in a coherent energy imaging system, and specifically in a light imaging system of the type having a coherent light source and at least one image lens disposed between an input signal plane and an output image plane are, discussed. The input signal plane is illuminated with the light source by rotating the lens about its optical axis. In this manner, the energy density of coherent noise diffraction patterns as produced by imperfections such as dust and/or bubbles on and/or in the lens is distributed over a ring-shaped area of the output image plane and reduced to a point wherein it can be ignored. The spatial filtering capability of the coherent imaging system is not affected by this noise elimination technique. NASA

N72-11569*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**MULTISPECTRAL IMAGING SYSTEM Patent Application**
Andrew E. Potter, Jr., inventor (to NASA) Filed 12 May 1971 13 p
(NASA-Case-MSC-12404-1; US-Patent-Appl-SN-142662) Avail: NTIS CSCL 20F

A system is disclosed for producing multiple images of a scene where the image is viewed from a single optical system and converted to separate displays at different light wavelengths. All the images are produced simultaneously. The system disclosed includes a Michelson interferometer which transmits the light intensity to a mosaic of independent light detectors. The detectors are independently coupled to an analog to digital converter which digitizes the electrical response of the detectors. The digital signals are processed in a Fourier transform unit to provide signals as a function of wavelength. The signals from the unit are stored in a memory unit and selected by a scanner unit as a function of wavelength and the increment of the detector mosaic and applied to a display device. By virture of the wavelength selection, different display devices are operated at different wavelengths to display the image at the selected wavelength. Author

N72-11570# Illinois Univ., Urbana.
**VELOCITY OF SOUND IN SOLID KRYPTON Ph.D. Thesis**
David Sander Kupperman Oct. 1970 128 p refs
(Contract AT(11-1)-1198)
(COO-1198-760) Avail: NTIS

Ultrasonic pulse-echo measurements were carried out on specimens of solid krypton prepared in a rigid-tail helium cryostat. Values were obtained from polycrystalline specimens for longitudinal sound waves from 52 to 115 K and transverse sound waves from 95 to 115 K, and from a single crystal for longitudinal sound waves travelling a nearly (110) direction from 94-114 K. Extrapolations to 0 K of polycrystalline velocities are consistent with previous deductions made from measurements of bulk modulus and heat capacity. The present velocity results are compared with model calculations based on m-6 Mie-Lennard-Jones pair potentials but there is only fair agreement. The adiabatic bulk modulus was obtained from the longitudinal and transverse polycrystalline velocities. The agreement between the model calculations and experimental values of the bulk modulus is again only fair. From the present bulk modulus values, the Gruneisen parameter of solid krypton was evaluated. From the longitudinal velocity in the nearly (110) direction and the polycrystalline velocities the second-order elastic constants were determined at 114 K. Author

N72-11571# Cornell Univ., Ithaca, N.Y. Materials Science Center.
**DIRECT GENERATION OF ACOUSTIC WAVES IN**

**CONDUCTING MATERIALS** Ph.D. Thesis
Martin R. Geerttner Jun. 1971 144 p refs
(Contract AT(30-1)-2150)
(NYO-2150-70; Rept-1524) Avail: NTIS

A method of generating (and detecting) ultrasound in metals through purely electromagnetic means was investigated. Radio frequency pulse echo techniques used for studying this process, called direct generation (or detection), are described. Measurements of the coupling efficiency of direct generation in a number of metals are reported for both the local and non local limits of electrical conductivity. Accurate measurements of the temperature, frequency, and magnetic field dependence have been made using frequencies between 3 and 100 MHz. A free electron theory which assumes specular scattering of electrons at the surface has been proposed by others. This theory is extended and quantitative comparisons with experimental measurements are presented. It has been found that, in the local limit of conductivity, experiment and theory are in good agreement for both transverse and longitudinal waves. Author

N72-11572# Tennessee Univ., Knoxville. Dept. of Physics.
**ELECTRONIC PROPERTIES OF LIQUIDS** Annual Progress Report, 1 Nov. 1970 - 31 Oct. 1971
Linda R. Painter Nov. 1971 14 p ref
(Contract AT(40-1)-3861)
(ORO-3861-3) Avail: NTIS

A newly assembled reflectance chamber and monochromator was leak tested, aligned, and placed in operating condition. Reflectance measurements were made on water at a 15 deg angle of incidence in the spectral region form 9.2 to 14.9 eV (1350 to 800 A). Values of n and k were obtained from a Kramers-Kroning analysis of the near-normal incidence reflectance and were used to verify experimental reflectance values obtained at 30, 45, 60, 65, and 70 deg angles of incidence. Studies were begun on long chain linear hydrocarbons having the general formula C(n)H(2n+2). These long chain hydrocarbons are particularly accessible to reflectance measurements at a liquid/near-vacuum interface because of their low vapor pressure at room temperature. Author

N72-11573# California Univ., Livermore. Lawrence Radiation Lab.
**WAVE PROPAGATION THEORY FOR ULTRASONIC TESTING**
R. A. Nickerson 7 May 1971 19 p refs Presented at the 1970 Ultrasonics Symp. of the IEEE, San Francisco, 8-9 Oct. 1970 Submitted for publication
(UCRL-73184; Conf-701050-1) Avail: NTIS

Two views of the theory of elastic wave propagation which describe ultrasonic testing are presented. The plane-wave theory in common use in the ultrasonics industry is shown to be inadequate. The Cagniard method of solution for spherical waves in cylindrical geometry is shown to be much more representative of observed ultrasonic phenomena. Author

N72-11574# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Pantex Plant.
**LIGHT INTENSIFICATION FOR FIRING SET TEST FIRES**
Elmer Laughter Apr. 1971 17 p Prepared for AEC, Albuquerque, N. Mex.
(Contract DA-11-173-AMC-487(A))
(MHSMP-71-11) Avail: NTIS

Several methods to intensify light for the smear cameras have been used. On firing set shots, the acceptable method has been a brushed-on aluminum silicofluoride and polyvinyl alcohol mixture. The aluminum silicofluoride is the light intensifier, and the polyvinyl alcohol solution is the bonding agent. This method has been a problem area for a long time as it has not provided a uniform light intensity. Tests are described which were conducted to arrive at a mixture and method of application which has been determined to be the most effective for optimum light intensification on the shots being tested. Author (NSA)

N72-11575# Harvard Univ., Cambridge, Mass. Acoustics Research Lab.
**SUBHARMONIC GENERATION IN ACOUSTIC SYSTEMS**
Nai-Chyuan Yen May 1971 142 p refs
(Contract N00014-67-A-0298-0007; NR Proj. 384-903)
(AD-725604; TM-65) Avail: NTIS CSCL 20/1

The report is concerned with the theoretical and experimental study of subharmonic generation in acoustic systems. The generalized formulation for lumped systems is considered for the case of three oscillators coupled through a nonlinear element. The resulting analysis indicates that the high frequency oscillation is unstable and its energy can be diverted to low frequency oscillations; that is, subharmonics are generated. Based on this mathematical model, the conditions for sustaining subharmonics are deduced in terms of the system's parameters. For distributed systems, the quasi-linear solution of the nonlinear wave equation, obtained by a two-variable (two-timing) perturbation method, shows that the nonlinear property of medium provides a coupling effect for signals of different frequencies. In a multi-resonant system, certain subharmonic modes, determined by a selection rule, can be excited by an external source. The present theory predicts the threshold for subharmonic generation as a function of the losses, nonlinearity, and detuning parameters of the system. Experimental measurements of such phenomena in an interferometer-type resonator, operated around 1.5 MHz in water, are consistent with the analytic results, provided that cavitation in the medium is carefully avoided. Author (GRA)

## 24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-11576 National Lending Library for Science and Technology, Boston Spa (England).
**THE DIPOLE MOMENT INDUCED DURING THE COLLISION OF TWO, NON-POLAR MOLECULES [DIPOLNYI MOMENT, INDUTSIRUEMYI PRI STOLKNOVENII DVUKH NEPOLYARNYKH MOLEKUL]**
A. P. Kouzov Sep. 1971 15 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Fiz. i Khim. (Leningrad), v. 16, 1969 p 46-52
(NLL-RTS-6676) Avail: Natl. Lending Library, Boston Spa, Engl., £1.50 or 5 NLL photocopy coupons

A model for the dipole moment induced by the collision of two non-polar molecules is obtained from the perturbation theory using completely antisymmetrized wave functions. The contributions to the short range part of the dipole are analyzed. For the evaluation of this term a wave function has been constructed which takes into account the molecular ionic states. The numerical calculations based on simple MO approximation for H2 molecule have been carried out for H2 + H2 collisions. Author

N72-11577# Montpellier Univ. (France). Dept. de Physique Mathematique.
**RHO-OMEGA MESONS MIXING**
F. M. Renard Jul. 1971 44 p refs Presented at the Intern. Summer Inst. in Theoret. Phys., Hamburg, Jul. 1971
(PM/71/5) Avail: NTIS

The three methods, used to investigate the possiblility of the mixing of rho-omega mesons during electromagnetic interactions are given. The methods are the Wigner-Weisskopf, the Stodolsky, and the propagator methods. E.H.W.

N72-11578 National Lending Library for Science and Technology, Boston Spa (England).
**TOWARD NEUTRON RADIOGRAPHY USING SMALL**

**ACCELERATOR SOURCES**
J. Berthod, Vu Hong Lac, and G. Breynat 22 Sep. 1971 11 p refs Transl. into ENGLISH from the Proc. of the 6th Intern. Conf. on Nondestructive Testing (Hanover) 1-5 Jun. 1970
(NLL-LB/G/2984-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Small accelerators are considered which produce neutrons by means of nuclear reactions between the accelerated particle and suitable target nuclei. Improving conditions of using a small accelerator as a source of thermal neutrons for neutron radiography and development of various techniques of detecting neutrons for the purpose of direct use of fast neutrons are studied. Possibilities and limitations in scanning some materials with fast neutrons are also reviewed. Author

**N72-11579** National Lending Library for Science and Technology, Boston Spa (England).
**UNDERWATER NEUTRON RADIOGRAPHY, SURVEILLANCE OF ACTIVE IN-PILE TESTS. FIRST RESULTS WITH COLD-NEUTRON RADIOGRAPHY**
J. P. Perves 19 Aug. 1971 17 p refs Transl. into ENGLISH from Proc. of 6th Intern. Conf. on Nondestructive Testing (Hanover) 1-5 Jun. 1970
(NLL-LB/G/2986-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Seven neutron radiography units immersed in pool reactors were installed. Industrial development of simple-designed equipment such as isotopic neutron sources and accelerators is reviewed, along with high quality fixed installations using neutron beams from research reactors or pulsed small reactors. Cowd neutron radiography is studied. J.A.M.

**N72-11580** National Lending Library for Science and Technology, Boston Spa (England).
**MAGNETIC ANALYSIS OF A BEAM OF POSITIVE IONS, ACCELERATED BY A VOLTAGE OF 5-30 kv, AFTER PASSING THROUGH AN INERT GAS**
N. V. Fedorenko et al 1971 23 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 24, no. 5, 1965 p 769-783
(NLL-NSTIC-Trans-2011-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

A beam of ions, monochromatic in composition and energy, was passed through a gas and analyzed in a magnetic field. Beams were studied which consisted, primarily, of the atomic ions: singly-charged He(+), N(+), Ne(+), K(+), Ar(+), Ca(+), I(+), Ba(+), Pb(+), and Bi(+); doubly-charged N(++), Ar(++), and Ba(++); triply-charged Ar(+++); and singly-charged molecular ions H2(+), H3(+), and N2(+). Inelastic processes linked to changes in the e/m of the ions in the beam occur in certain instances in collisions between an ion and a helium, neon, argon, or krypton atom, or a hydrogen or nitrogen molecule. For singly-charged atomic ions the existence of a process of breaking away of a single electron from the ion casing was established (stripping of ions). The scattering cross section for the process is greater for ions of heavy elements (for the process Ba(+) yields Ba(++), the cross section is sometimes greater than 10 to the minus 16th power sq cm). Processes were also detected for Ba(++) yields Ba(+++). An evaluation was carried out for the effective cross section of the ions H2(+), H3(+), and N2(+). Author

**N72-11581** New York Univ., N.Y.
**A QUANTUM FIELD THEORY WITHOUT CUTOFFS FOR SELF-INTERACTING BOSONS Ph.D. Thesis**
Lon Michael Rosen 1970 113 p
Avail: Univ. Microfilms Order No. 70-19026

A P(phi) model is considered in two-dimensional space-time, that is, a scalar boson field with self-interaction given by an arbitrary Wick polynomial. The Hamiltonian on Fock space is by imposing three cutoffs: a box cutoff; and ultraviolet cutoff; and a space cutoff given by a cutoff function g(x). These are subsequently removed, yielding a quantum field theory without cutoffs. As the first two are removed the resolvents of the cutoff Hamiltonians converge uniformly and this leads to the essential self-adjointness of the spatially cutoff Hamiltonian H(g). In a spatially cutoff theory, functions of the local fields are independent of g(x) provided that g(x) = 1 on a sufficiently large set. As the space cutoff g is removed, the Hamiltonians H(g) do not converge to an operator in Fock space. However the vacuum expectation values converge and enable us to obtain a representation of the P(phi) theory without cutoffs on a now Hilbert space. On this physical Hilbert space the Hamiltonian is a positive self-adjoint operator with a physical vacuum.
Dissert. Abstr.

**N72-11582** California Univ., Berkeley.
**RESONANCE PRODUCTION IN THE REACTION PION (PLUS) D YIELDS P P PION PION FROM 1.1 TO 2.3 GeV/c Ph.D. Thesis**
Robert Jerome Manning 1969 139 p
Avail: Univ. Microfilms Order No. 70-17616

In an analysis of 229,000 pictures of positive pions at incident momenta of 1.1 to 2.3 GeV/c in the deuterium filled 72 in. bubble chamber, 41,045 examples of the reaction pion(+) deuterium yields PP pion(+) pion(-) are identified. A phase shift analysis on the angular distribution moments of off-mass-shell pion-pion scattering for low momentum transfer events is attempted. This resulted in 4 distinct solutions for the L = 0, J = 0 pion-pion scattering phase shift. At values of center-of-mass energy less than 2.1 GeV, forward peaking in the single meson exchange forbidden reaction is found. In the same reaction, backward peaking inconsistent with simple J = 1/2 baryon exchange in the u-channel was also observed. Resonance production in the reaction pion(+) deuterium yields PP(neutrals) from 1.1 to 2.3 GeV/c is also studied. Dissert. Abstr.

**N72-11583** Stanford Univ., Calif.
**ENERGY ACCOMODATION DURING THE HETEROGENEOUS RECOMBINATION OF ATOMS ON METAL SURFACES Ph.D. Thesis**
Gerald Allan Melin 1970 187 p
Avail: Univ. Microfilms Order No. 70-18448

Contrary to the assumption of complete transfer of recombination energy, evidence of only partial accommodation was found for oxygen and hydrogen recombination on gold, copper, cobalt, iron, nickel, platinum, and tungsten surfaces. Values of the fraction of the heat of recombination transferred to the metal were found to vary from 0.1 for hydrogen or oxygen on iron to approximately 1 for oxygen recombination on silver. In addition to the measurement of energy accommodation coefficients, values for the heterogeneous recombination probabilities gamma, were determined. Results of these measurements varied from gamma = 0.00013 for oxygen recombination on pyrex to gamma = 0.24 for oxygen on silver. The measured values of gamma were in good agreement with previous literature results. Dissert. Abstr.

**N72-11584** Stanford Univ., Calif.
**MEASUREMENTS OF PROTON RADIATION DAMAGE AND CARRIER DIFFUSIVITIES IN SILICON THROUGH OBSERVATIONS OF THE DRIFT OF ELECTRON-BEAM-INDUCED CARRIERS Ph.D. Thesis**
Thomas William Sigmon 1970 93 p
Avail: Univ. Microfilms Order No. 70-18476

Measurements of (1) the variation of electron and hole diffusivity and drift velocity in the warm electron range of electric field (1 to 50 kV/cm) and (2) the introduction rate and annealing characteristics of damage resulting from implanting 2.8 MeV protons in the silicon lattice are presented. Both measurements involved the observation and analysis of the transient currents produced as a thin layer of warm carriers pass through the depletion region of a diode structure for the measurement technique. The theoretical background of the experimental technique is reviewed, and the experimental apparatus used to implement the experiment (swept electron beam system) is described. Also, a method of using a sampling oscilloscope in

conjunction with an analog to digital converter and averaging system is described. Fabrication of the high resistivity (> 20,000 ohm-cm) diodes used in the experiments is also described.
Dissert. Abstr.

N72-11585 Princeton Univ., N.J.
**THE PROCESS n PLUS p YIELDS d PLUS GAMMA: A TEST OF TIME REVERSAL INVARIANCE Ph.D. Thesis**
Carl E. Friedberg 19 Nov. 1971 166 p
Avail: Univ. Microfilms Order No. 70-14207

The process n + p yields d + gamma was investigated as a test of time reversal invariance. The differential and total cross sections obtained were compared with those for the process gamma + d yields n + p, as a test of reciprocity, for neutron energies between 160 and 640 MeV. The total cross sections measured are in agreement with existing data. The differential cross sections measured are in agreement except in the energy range 520 < T sub n < 640 Mev. Dissert. Abstr.

N72-11586 Yale Univ., New Haven, Conn.
**OVERLAPPING RESONANCES Ph.D. Thesis**
J. Arthur Snoke 1969 94 p
Avail: Univ. Microfilms Order No. 70-16256

An example of overlapping resonances, namely a three particle system using an isobar model, is presented. The enhancement in the three particle mass by the overlapping of two particle resonances is explored. It was shown that when calculations are done correctly and the results given the proper interpretation, the enchancements of previous models do not appear. It was therefore concluded that enhancements in the three particle mass cannot be caused by overlapping two particle resonances. Dissert. Abstr.

N72-11587 Ohio State Univ., Columbus.
**DETERMINATION OF THE AXIAL VECTOR TO VECTOR RATIO IN THE BETA DECAY OF THE LAMBDA HYPERON Ph.D. Thesis**
Alan Jerald Stevens 1970 142 p
Avail: Univ. Microfilms Order No. 70-19367

A counter-optical spark chamber experiment to study the beta decay of the Lambda hyperon was performed at the Zero Gradient Synchrotron. Lambda hyperon beta events are identified by a combination of fiducial volume, time-of-flight, and kinematic requirements. The axial vector to vector ratio (C sub A/C sub V) is determined from the up-down asymmetries of the decay products with respect to the polarized lambdas. Analysis of 44 identified Lambda hyperon beta events gives C sub A/C sub V = -.41 (+23) sub infinity which is consistent with, but does not confirm, the theoretical prediction of Cabibbo. Dissert. Abstr.

N72-11588 Rochester Univ., N.Y.
**ON FINITE QUANTUM ELECTRODYNAMICS Ph.D. Thesis**
Mark Aaron Samuel 1970 101 p
Avail: Univ. Microfilms Order No. 70-17907

The question of the finiteness of quantum electrodynamics is examined from several points of view. The high K2 behavior of the renormalized photon propagator is considered in the context of the renormalization group. It was shown that the coefficients in the perturbation expansion of this quantity are not all independent. In each order there are only 2 independent coefficients, namely the finite and the single-log terms. The leading coefficient in each order is given. The question of finite charge renormalization is further studied in the case that the domain of pure electrodynamics is enlarged to include other particles. Several models are considered. It is shown that if one includes two spin-one-half particles with unequal charge and unequal mass, the possibility of finite charge renormalization in sixth order exists. A detailed calculation is performed which indicates how strong interaction effects can enter this question. It suggests the reasonableness of the possibility that the charge renormalization may be finite only after strong interactions are included in the theory. Dissert. Abstr.

N72-11589 Wisconsin Univ., Madison.
**SOME STRANGE PARTICLE FINAL STATES PRODUCED BY 7 BeV/c PION MINUS ON PROTONS Ph.D. Thesis**
Andres Peekna 1970 167 p
Avail: Univ. Microfilms Order No. 70-12746

Production of resonances involving strange particles is surveyed. Only well established resonances were clearly seen. Data from the University of Toronto and the University of Colorado were included for some reactions. These are an indication that the eta (1070) may be produced most strongly in association with a nucleon and a pion. Data on quasi-two-body reactions were found to be generally consistent with the Regge pole model but there are some indications that the highest-lying trajectory (K*) does not always exclusively dominate at this energy. Dissert. Abstr.

N72-11590 California Inst. of Tech., Pasadena.
**A SEARCH FOR FRACTIONALLY CHARGED PARTICLES IN COSMIC RAYS AND A THEORETICAL INTERPRETATION OF THE RESULTS Ph.D. Thesis**
Charles Douglas Orth 1970 285 p
Avail: Univ. Microfilms Order No. 70-18042

An array of two spark chambers and six trays of plastic scintillation counters was used to search for unaccompanied fractionally charged particles in cosmic rays near sea level. No acceptable events were found with energy losses by ionization between 0.04 and 0.7 that of unit-charged minimum-ionizing particles. New 90%-confidence upper limits were thereby established for the fluxes of fractionally charged particles in cosmic rays for minimum-ionizing particles with charges 1/3 and 2/3. In order to be certain that the spark chambers could have functioned for the low levels of ionization expected from particles with small fractional charges, tests were conducted to estimate the efficiency of the chambers as they have been used in this experiment. These tests showed that the spark-chamber system with the track-selection criteria used might have been over 99% efficient for the entire range of energy losses considered. Lower limits were then obtained for the mass of a quark by considering the above flux limits and a particular model for the production of quarks in cosmic rays. Dissert. Abstr.

N72-11591 Tufts Univ., Medford, Mass.
**TOTAL CROSS SECTIONS OF HEAVY ELEMENTS FOR 100 TO 150 MeV NEUTRONS Ph.D. Thesis**
Robert Julius Schneider, III 1968 102 p
Avail: Univ. Microfilms Order No. 70-16920

The neutron total cross sections were measured to an accuracy of one percent for a series of five elements, at six different incident neutron energies. The elements are aluminum, copper, cadmium, lead, and uranium. The energies range from 100 MeV to 150 MeV in 10 MeV steps, with an energy resolution of one MeV. The measured total cross sections together with published inelastic cross sections, were analyzed in terms of the nuclear optical model. The real and imaginary parts of the central nuclear potential were determined at each energy. It was found that no single set of radial parameters was optimum for all energies. Both the cross sections and the potentials extrapolate well to the values measured previously up to 100 MeV. Dissert. Abstr.

N72-11592 California Univ., Berkeley.
**NUCLEAR SPINS, P(3)1 AND P(3)2 HYPERFINE STRUCTURES, AND NUCLEAR MOMENTS OF Ge-69 AND Ge-75, AND P(3)2 HYPERFINE STRUCTURE OF Ge-71 Ph.D. Thesis**
Abiodun Francis Oluwole 1969 98 p
Avail: Univ. Microfilms Order No. 70-17633

The atomic beam magnetic resonance technique was used to measure the nuclear spin and the 3P2 hyperfine structure constants a and b for 37-hr Ge-69, the 3P2 constant a for 11-day Ge-71, and the nuclear spin and constant a for Ge-75 in the 3P1 and 3P2 electronic states. The nuclear moments were inferred with the use of the Fermi-Segre formula from the

corresponding interaction constants. Relativistic effects account for about 25% of the a values, while the remainder is attributed to effects of configuration interaction. The nuclear spins are predicted correctly by the shell model, while the quasiparticle nuclear thoery of Migdal was found to predict the nuclear moments more accurately than the shell model. Dissert. Abstr.

N72-11593 New York Univ., N.Y.
**DETERMINATION OF THE NUCLEAR MAGNETIC MOMENT OF Hg-203 BY MEANS OF OPTICAL PUMPING AND POLARIZATION OF THE 2S1/2 GROUND STATE OF EVEN ISOTOPES OF THE MERCURY ION BY STEPWISE ELECTRON EXCITATION Ph.D. Thesis**
Richard Lien-Chao King 1970 130 p refs
Avail: Univ. Microfilms Order No. 70-19009

A direct measurement of the ratio of the nuclear g values of Hg-201 and Hg-203 was obtained by optical pumping of the 6s2 1S0 atomic ground state. The result is g(Hg-201)/g(Hg-203) = -1.09984(18). Without diamagnetic corrections and using the value of mu-201 = -0.551344(9) mu sub N, the nuclear magnetic moment of the 47-d radiosiotope Hg-203 mu-203 = 0.83549(13) mu sub N was obtained. The pile-produced, (n,gamma) reaction was electromagnetically enriched such that the ratio of Hg-203 to Hg-201 in the resonance cell was approximately 10 to the 13th power. The 6s 2S1/2 ground ionic state of even isotopes of mercury was polarized in a stepwise excitation process from the atomic 6s2 1S0 ground state via the metastable 6s 6p 3P2 state. The latter was optically pumped with circularly polarized 6461 A (6s 7s 3S1 - 3P2) radiation. Paramagnetic resonance was used to determine the polarization of the even-isotope ground state ion to be 15%. Dissert. Abstr.

N72-11594 California Univ., Riverside.
**MANY BODY THEORY FOR HYPERFINE INTERACTIONS IN NITROGEN AND PHOSPHOROUS Ph.D. Thesis**
Nader Chand Dutta 1969 138 p
Avail: Univ. Microfilms Order No. 70-19233

The Brueckner-Goldstone many-body theory was used to calculate the magnetic hyperfine structure constant alpha for atomic nitrogen and phosphorous in their 4S3/2 ground state. The theoretical value of alpha for phosphorus was calculated to be +49.795 Mc/sec, which is in substantial agreement with experiment, with respect to both magnitude and sign. Part of the dynamic correlation correction was due mainly to correlation between 3s and 3p electrons, and also to 3s-2s and 3s-1s contributions. In addition, exclusion principle violation and residue, representing important physical effects, were found to make a sizable contribution. Dissert. Abstr.

N72-11595* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**APPARATUS FOR OBTAINING ISOTROPIC IRRADIATION OF A SPECIMEN Patent**
Lester Katz, inventor (to NASA) Issued 13 Jul. 1971 6 p Filed 3 Sep. 1969 Supersedes N70-12656 (08 - 02, p 356)
(NASA-Case-MFS-20095; US-Patent-3,593,024;
US-Patent-Appl-SN-855004; US-Patent-Class-250-49.5B;
US-Patent-Class-250-49.5TE; US-Patent-Class-250-51;
US-Patent-Class-250-52) Avail: US Patent Office CSCL 20H

An apparatus for moving a film emulsion in a path of high energy particles to obtain essentially an isotropic exposure is described. The apparatus rotates the film on a turntable along one axis and simultaneously shifts the turntable up and down within a limited range. Official Gazette of the U.S. Patent Office

N72-11596# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
**LIFE TIME MEASUREMENTS ON THE FIRST EXCITED 1/2(PLUS) LEVELS OF THE ATOMIC NUCLEI I-123, I-121, AND I-119 Ph.D. Thesis [MESSUNG DER LEBENSDAUER DES ERSTEN ANGEREGTEN 1/2(PLUS) -ZUSTANDS DER ATOMKERNE I-123, I-121, UND I-119]**
Heinrich Schrader 1971 73 p refs In GERMAN
Avail: NTIS

Photomultiplier coincidence measurements on the 1/2(+) level lifetimes in neutron depleted iodine atomic nuclei are reported. The observed levels were populated with half times of 2.1 h up to 6 min from Xe decays. Photon transfer probabilities of five analog levels were compared systematically with nuclear model predictions. For the E2 transformation of the 1/2(+) to the 5/2(2) level in the atomic nuclei I-127 to I-119, experimental photon transfer probability was accelerated by the factors 6 to 27 in comparison with single shell theoretical model calculations. Transl. by G.G.

N72-11597# Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany).
**[STUDIES IN NUCLEAR PHYSICS AND COSMIC CHEMISTRY PERFORMED DURING 1969 AND 1970] Annual Report, 1970 [JAHRESBERICHT 1970]**
1970 254 p refs In GERMAN
Avail: NTIS

A summary is presented of all nuclear research performed during 1970 and of all cosmic chemistry studies made during 1970 and 1969. Prepartions continued for the installation of a Q 3D spectrograph and the planning for the cyclotron progressed. Lunar probe analyses with geophysical analogs were emphasized in cosmic chemistry. Transl. by G.G.

N72-11598# Hamburg Univ. (West Germany).
**THE TOTAL EFFECTIVE CROSS SECTION FOR THE PHOTOPRODUCTION OF HADRONS ON HYDROGEN, DEUTERIUM, AND HEAVY NUCLEI BETWEEN 1.5 AND 6.5 GeV Ph.D. Thesis [DER TOTALE WIRKUNG-SQUERSCHNITT FUER DIE PHOTOPRODUKTION VON HADRONEN AN WASSERSTOFF, DEUTERIUM UND SCHWEREN KERNEN ZWISCHEN 1.5 UND 6.5 GEV]**
Beate Naroska 1970 122 p refs In GERMAN
Avail: NTIS

Total effective cross section measurements for the photoproduction of hadrons on H2, D2, and seven heavy nuclei are reported. Measurements were obtained by energy marked photon beam and a counting detector for hadronic reactions in the region 1.5 smaller than or equal to E sub light quanta smaller than or equal to 6.5 GeV. The accuracy for H2 and D2 is about plus or minus 4.5%. An additional error of 5 to 20%, depending on mass number, is observed in measurements on heavy elements. Transl. by G.G.

N72-11599# Hamburg Univ. (West Germany).
**FINITE ENERGY SUMMATION RULES FOR THE K-MATRIX AND THEIR APPLICATION IN PION-NUCLEON SCATTER Ph.D. Thesis [FINITE ENERGY-SUMMENREGELN FUER DIE K-MATRIX UND IHRE ANWENDUNG AUF DIE PION-NUCLEON-STREUUNG]**
Fridger Schrempp 1970 67 p refs In GERMAN
Avail: NTIS

Proposed are new finite energy sum rules that contain only Regge poles on the high energy side for the single scattering term in a multiple scattering model. A hypothesis is formulated that identifies the reggefied Born amplitude with the single scattering K-matrix term. Application of K-matrix continuous moment sum rules to the pion nucleon scattering in the isospin exchange channel is demonstrated. Transl. by G.G.

N72-11600# Hamburg Univ. (West Germany).
**HIGHER PARTIAL WAVE EFFECT ON PHOTOREACTIONS ON THE NUCLEON Ph.D. Thesis [EINFLUSS HOEHERER PARTIALWELLEN IN PHOTOREAKTIONEN AM NUKLEON]**
Barbara Schrempp 1970 90 p refs In GERMAN
Avail: NTIS

The vector dominance model is used to analyze resonant photoproduction of vector mesons by polarizing photons. An approximative spinning function for high resonance spins is

formulated and used in combination with the quark model to analyze resonant processes in dominant magnetic multipolar excitation as well as in dominant magnetic proton nucleon decay. Transl. by G.G.

N72-11601# Hamburg Univ. (West Germany).
**SCATTERING THEORY FOR STRONG AND ELECTROMAGNETIC EXCHANGE EFFECTS IN RELATIVISTIC TWO PARTICLE SYSTEMS: APPLICATION TO THE NUCLEON-NUCLEON EXCHANGE EFFECT AND DEUTERON PHOTOFISSION IN THE CONTEXT OF THE ONE BOSON EXCHANGE MODEL Ph.D. Thesis [STREUTHEORIE FUER STARKE UND ELEKTROMAGNETISCHE WECHSELWIRKUNGEN RELATIVISCHER ZWEITEILCHENSYSTEME: ANWENDUNG AUF DIE NUKLEON-NUKLEON-WECHSELWIRKUNG UND DIE PHOTOSPALTUNG DES DEUTERONS IM RAHMEN DES EIN-BOSON-AUSTAUSCHMODELLS]**
Gerrit Schierholz 1970 54 p refs In GERMAN
Avail: NTIS

Relativistic quantum mechanical methods are used to analyze electromagnetic exchange effects in photon-photon scattering that includes NN-exchange. The model describes the NN-exchange up to 650 MeV quite acceptable; the D-wave probability of the deuteron ground level is determined as 4.18%. It is shown that photofission of the deuteron depends mainly on the D-wave probability of the approximated wave functions.
Transl. by G.G.

N72-11602# Tokyo Univ. of Education (Japan). Dept. of Physics.
**RANDOM FLIGHTS AND AN OPTICAL MODEL OF SCATTERING**
Tadashi Miyazaki Jun. 1971 8 p refs Sponsored in part by the Yukawa Post Doctoral Fellowship Prepared in cooperation with Tokyo Univ.
(TUEP-71-26) Avail: NTIS

It is proposed that high energy elastic scattering be based on the mechanism of random walks. The differential cross section is formulated according to this mechanism, and form factors are interpreted as the modulus of elasticity. Author

N72-11603# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
**QUARK MODEL OF DIFFRACTIVE PRODUCTION WITH QUARK SPIN FLIP**
A. LeYaouanc, L. Oliver, O. Pene, and J.-C. Raynal Jun. 1971 22 p refs
(LPTHE-71/21) Avail: NTIS

The presence of diffractive production of isobars with change of SU(6) representation is interpreted, in the frame of the quark model, by a quark spin flip. This quark spin flip must occur in the Breit frame of the p-N* transition, because it is there that the SU(6) nonrelativistic wave functions are expected to give the best results. The existence of a large quark spin flip is in turn related to the center of mass s-channel helicity conservation of elastic scattering. Quantitative calculations were made for pion proton yields pion N*(1520) and for pion proton yields pion N*(2190). The spin structure and density matrix of all the N* in pion proton yields pion N*(+) was predicted and a simple result was obtained in the Gottfried-Jackson frame. The contradiction between the quark model and Morrisson's rule is discussed.
Author

N72-11604*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**COLLISIONAL EXCITATION OF THE HIGHLY EXCITED HYDROGEN ATOMS IN THE DIPOLE FORM OF THE SEMICLASSICAL IMPACT PARAMETER AND BORN APPROXIMATIONS**
Kazem Omidvar Oct. 1971 12 p refs
(NASA-TM-X-65743; X-640-71-428) Avail: NTIS CSCL 20H

Expressions for the excitation cross section of the highly excited states of the hydrogenlike atoms by fast charged particles have been derived in the dipole approximation of the semiclassical impact parameter and the Born approximations, making use of a formula for the asymptotic expansion of the oscillator strength of the hydrogenlike atoms given by Menzel. When only the leading term in the asymptotic expansion is retained, the expression for the cross section becomes identical to the expression obtained by the method of the classical collision and correspondence principle given by Percival and Richards. Comparisons are made between the Bethe coefficients obtained here and the Bethe coefficients of the Born approximation for transitions where the Born calculation is available. Satisfactory agreement is obtained only for n yields n + 1 transitions, with n the principal quantum number of the excited state. Author

N72-11605*# Buresu of Radiological Health, Rockville, Md.
**CYCLOTRON PRODUCTION OF I-123: AN EVALUATION OF THE NUCLEAR REACTIONS WHICH PRODUCE THIS ISOTOPE**
Vincent J. Sodd, Kenneth L. Scholz, James W. Blue (NASA. Lewis Research Center, Cleveland, Ohio), and Henry N. Wellamn Oct. 1970 45 p refs Sponsored in part by NASA
(NASA-TM-X-67336; BRH/DMRE-70-4) Avail: NTIS
CSCL 20H

The reactions studied which produce I-123 directly were Sb-121(He-4,2n) I-123, Sb-121(He-3,n) I-123, Te-122(d,n) I-123, Te-122(He-4,p2n) I-123, Te-122(He-3,pn) I-123, and Te-123(He-3,p2n) I-123. Reactions which produce I-123 indirectly through the positron decay of 2.1-hour Xe-123 were Te-122(He-4,3n) Xe-123, Te-122(He-3,2n) Xe-123 and Te-123(He-3,3n) Xe-123. Use of the gas flow I-123 cyclotron target assembly is recommended for the production of I-123 with radicchemical purity greater than 99.995%. Author

N72-11606*# Translation Consultants, Ltd., Arlington, Va.
**THEORY OF INELASTIC COLLISIONS BETWEEN ATOMS [THEORIE DER UNELASTISCHEN STOESSE ZWISCHEN ATOMEN]**
E. C. G. Stueckelberg Washington NASA Nov. 1971 50 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), v. 5, 1932 p 369-422
(Contract NASw-2038)
(NASA-TT-F-13970) Avail: NTIS CSCL 20H

The curves of missing interaction energy that is responsible for transitions between the two energy states are studied. Both the general case, in which the curves do not intersect, and the other case, where they do intersect, are treated by a different method and compared. Author

N72-11607# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
**AN APPROACH TO REGGE BEHAVIOUR AND DUALITY BASED ON AN INFINITE SUM OF ONE-PARTICLE-EXHANGE AMPLITUDES**
Kisei Kinoshita, Masanori Kobayashi, and Kunio Shiga (Kyusho Sangyo Univ., Fukuoka, Japan) Aug. 1971 48 p refs
(RIFP-130) Avail: NTIS

The implication of Regge asymptotic behaviour is studied on the basis of an infinite sum of one-particle-exchange (IOPE) amplitude, which provides a wide framework including various versions of dual amplitudes. The imaginary part of Regge behaved amplitude comes from the s-u crossing term of the IOPE amplitude, accompained with the divergence of IOPE expression. Duality between t-poles and u- or s-singularities is neccessarily contained in Regge behaviour. A general expression for the IOPE amplitude satisfying full Regge behaviour is pursued and comments on related models are given in connection with the approach. Phenomenological aspects of various solutions are also discussed. Author

N72-11608# Tokyo Univ. of Education (Japan). Dept. of Physics.
**HADRONIC SCATTERING AMPLITUDES IN THE QUARK MODEL 3: INVESTIGATION OF THE DYNAMICAL CONSTRAINTS AND SCALE TRANSFORMATION FOR INTERNAL RELATIVE COORDINATES**
Tsunehiro Kobayashi Sep. 1971 21 p refs
(TUEP-71-35) Avail: NTIS

The dynamic constraints of the model are investigated from the viewpoint of the geometric structure of vertex functions. In particular, scale transformation for internal relative coordinates is introduced in order to interpret the constraints. The internal spatial wave functions of bound states of the quark-antiquark system in the rest frame are represented mathematically. The model may be related to the light cone analysis in terms of operator product expansion. Author

N72-11609# Minnesota Univ., Minneapolis. Particle Technology Lab.
**THE ELECTRICAL CHARGING OF SMALL PARTICLES AT LOW PRESSURES Progress Report**
Benjamin Y. H. Liu and Kenneth T. Whitby Oct. 1970 10 p
(Contract AT(11-1)-1248)
(COO-1248-24; PR-8; Rept-147) Avail: NTIS

The effect of image force and the statistics of the charging process are being studied. The application of results of the fundamental charging studies to problems in the science and technology of aerosols is also being investigated. One study concerns the development of a low pressure electrical method for the sizing and classification of aerosol particles in the 0.02 to 12 micron range. Another concerns the accurate measurement of the slip correction to Stokes' law for solid latex particles. Inertial impaction of aerosols are being studied, and aerosol size distribution measuring devices were developed. Author (NSA)

N72-11610# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
**NUKLEONIKA, VOLUME 15, NO. 3, 1970**
1970 74 p refs Transl. into ENGLISH from Nukleonika (Poland), v. 15, no. 3, 1970 p 237-316 Sponsored in part by AEC and NSF
(AEC-Tr-7102/3; TT-70-55010/3; UC-34) Avail: NTIS

The effect of the distribution of gas parameters in a cross sectional area of an MHD generator upon its electrical performance was analyzed. The method of electrical equivalent circuits was used. The problem was divided into two parts in order to obtain results in general form: (1) the nonuniformity of gas parameters in a y direction only, and (2) the gas nonuniformity in a z direction. The derived expressions make it possible to determine the distribution of electrical values (current density, electrical potential, and effective gas conductivity) in the channel cross section of the MHD generator, and to calculate its terminal values when the distribution functions of the gas parameters are specified. Author

N72-11611# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
**CURIUM PROCESS DEVELOPMENT. 3-7: EMISSION SPECTROGRAPHIC DETERMINATION OF METALLIC IMPURITIES IN CURIUM OXIDE AND MIXED CURIUM-AMERICIUM OXIDE**
R. H. Gaddy 29 Oct. 1971 15 p refs
(Contract AT(07-2)-1)
(DP-1268; DR-1852; TID-4500; UC-4) Avail: NTIS

Semiquantitative emission spectrographic methods were developed for the determination of impurities in curium oxide and mixed curium-americium oxide. Twenty-one elements (Ag, Al, B, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, and Zn) were determined by a gallium oxide carrier technique. Zirconium was determined by total burn method with a direct current arc. The methods are estimated to be accurate to within a factor of two. Author (NSA)

N72-11612# Wayne State Univ., Detroit, Mich. Dept. of Physics.
**ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIATION EFFECTS IN SOLIDS AND CHEMICAL COMPOUNDS Technical Progress Report, 1 Jun. 1970 - 31 May 1971**
Yeong Wook Kim 15 Jun. 1971 15 p refs
(Contract AT(11-1)-1054)
(COO-1054-52) Avail: NTIS

Research on the radiation effects in superconducting and optical materials is briefly reported. Lead samples were subjected to 40 keV X-irradiation at 4.2 K, and I-V graphs indicated the effective resistance and critical current. Techniques for studying magnetic, electrical impedance, and tunneling properties of single and superconducting pair electrons are mentioned. Radiation effects on calcium fluoride doped with Gd(3+) are summarized. N.E.N.

N72-11613# Case Western Reserve Univ., Cleveland, Ohio.
**A RESEARCH PROGRAM IN HIGH ENERGY ACCELERATOR PHYSICS AND LOW LEVEL COUNTING ELEMENTARY PARTICLE PHYSICS Technical Report, 1 Oct. 1970 - 30 Sep. 1971**
T. L. Jenkins Feb. 1971 71 p refs
(Contract AT(11-1)-1749)
(COO-1749-22) Avail: NTIS

Administrative aspects of the high-energy physics research program are discussed. Results of an experiment to measure the differential cross section of the pion(-) ± proton yields pion (0) ± neutron interaction at large momentum transfers are presented. A search for the double beta decay of neodymium 150 using a magnetic spectrometer is described. NSA

N72-11614# Oregon Univ., Eugene. Inst. of Theoretical Science.
**PREDICTION IN QUANTUM PHYSICS**
Paul L. Csonka Nov. 1970 12 p refs Sponsored in part by AEC
(RLO-2041-55; UO-ITS-1073) Avail: NTIS

One consequence of dropping the (heretofore unjustified) reduction postulate of orthodox quantum mechanics is that, even if one measures the values of a complete set of commuting operators belonging to a system at any particular time, one can not calculate the probability of a state of the system very far in the future or in the past. Quantum cosmology is affected by this. Author (NSA)

N72-11615# Illinois Univ., Urbana. Materials Research Lab.
**THERMALLY EXCITED CONFIGURATIONS OF LOCAL MOMENTS: TRANSITIONAL IMPURITIES IN SIMPLE METALS Ph.D. Thesis**
James John Peters Jun. 1971 131 p refs
(Contract AT(11-1)-1198)
(COO-1198-820) Avail: NTIS

Susceptibilities are reported as a function of temperature of the 3d transitional elements, V, Cr, Mn, Fe, Co, and Ni, in liquid solvents formed from Cu, Zn, Ga, Ge, As, and mixtures of these elements. The susceptibilities vary systematically with e/a. These and other data available in the literature are analyzed, using a simple quasi-atomic model in which the impurity spin Hamiltonian includes a term written as an even function of the impurity total spin operator to treat the region of spin near zero. The model represents spin fluctuations near the Hartree-Fock instability by a thermal distribution of localized excited impurity spin configurations. It gives a coherent account of the available data concerning local moments at elevated temperatures and allows the role of solvent properties in local moment creation to be distinguished from specific impurity properties related to the excitation energies. Author (NSA)

N72-11616# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.
**DYNAMIC ISOTOPE EFFECTS IN ION-MOLECULE**

**REACTIONS Ph.D. Thesis**
Arthur Stephen Werner Apr. 1971 166 p refs
(Contract W-7405-eng-48)
(UCRL-20363) Avail: NTIS

An ion beam scattering cell apparatus was employed to measure product ion velocity and angular distributions from the reactions of O2(+) with HD. At collision energies below 4 eV the product distributions are isotropic about and peak at the center-of-mass velocity, indicating that O2D(+) and O2H(+) are produced primarily from the decay of a long-lived complex and the products are highly internally excited. At high collision energies the O2(+)(HD,H)O2D(+) and O2(+)(HD,D)O2H(+) reactions are direct. The O2H(+) is strongly forward scattered and the O2D(+) is primarily backscattered. Spectator stripping is invoked. Integrated total cross sections are calculated, and the O2D(+)/O2H(+) ratio varies from 5 to 0.9. The O2(+)(HD,OH) OD(+) and O2(+)(HD,OD)OH(+) reactions were investigated in the relative collision energy range from 4.3 to 21.5 eV and are direct. The OD(+)/OH(+) ratio decreases from near unity to 0.07. Contour maps of the O2(+)(H2,O)H2O(+) reaction were measured at collision energies of 7.3 and 8.9 eV. Quasi-equilibrium theory was used to calculate product ion intensity ratios and lifetimes of the H2O2(+) complex. Author (NSA)

N72-11617# California Univ., Berkeley. Lawrence Radiation Lab.
**TRACE ELEMENT ANALYSIS BY X-RAY FLOURESCENCE**
F. S. Goulding and J. M. Jaklevic May 1971 54 p
(Contract W-7405-eng-48)
(UCRL-20625) Avail: NTIS

The use of semiconductor detector X-ray fluorescence spectrometers for analysis of trace element constituents of materials trometers for analysis of trace element constituents of materials is described. The results presented illustrate the value of the technique in a wide variety of applications including analysis of food samples, biological specimens, and air filters. Levels of detection in these samples are less than 0.1 ppm. These results are achieved using X-ray excitation of the samples; they can therefore be achieved using only a small laboratory instrument and in a time measured only in minutes. Sample preparation is very simple compared with other techniques of comparable sensitivity. Author (NSA)

N72-11618# Oak Ridge National Lab., Tenn.
**ELDOSE PROGRAM FOR THE CALCULATION OF ABSORBED DOSE DISTRIBUTIONS IN THIN SHIELDS**
J. Bourriaau and R. Schuttler Dec. 1970 22 p refs Transl. into ENGLISH from the French report
(ORNL-TR-2480; NT/02/20/70) Avail: NTIS

A computer program was generalized for a study of absorbed dose distributions in thin films during exposure to any proton or electron flux in space environments. The program permits a prediction of the absorbed dose distributions on a given orbit (approximately omnidirectional and polykinetic) and the adjustment of irradiation parameters (flux and energy) for the simulation with the particle accelerator (in monokinetic and monodirectional beams). NSA

N72-11619# Illinois Univ., Chicago. Dept. of Physics.
**STUDY OF THE OMEGA-ZERO SPIN-DENSITY MATRIX ELEMENTS IN THE REACTION PI MINUS PROTON GOES TO OMEGA ZERO NEUTRON AT 3.65, 4.5, AND 5.5 GeV/c Ph.D. Thesis**
Eli Ira Rosenberg Jun. 1971 107 p refs
(Contract AT(11-1)-1195)
(COO-1195-214) Avail: NTIS

A study was made of the omega meson(0) spin-density matrix elements in the reaction pion(-) proton yields omega meson(0) neutron. The data were collected using a combination of scintillation counters and optical spark chambers designed to detect events of the type pion(-) proton yields pion(+) pion(-) gamma gamma neutron. Incident pions of momenta 3.65, 4.5, and 5.5 GeV/c were produced by an internal target in a zero gradient synchrotron. The values obtained for the omega meson(0) spin-density matrix elements are inconsistent with the predictions of a simple model which allows for Reggeized rho meson(765) and baryon(1235) exchange. Author (NSA)

N72-11620# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant
**USE OF AUTOMATION AND COMPUTERIZATION IN THE OAK RIDGE Y-12 PLANT'S ENVIRONMENTAL MONITORING PROGRAMS**
C. M. West and L. M. Scott Jul. 1971 14 p refs Presented at the Intern. Symp. on Rapid Methods for Measuring Radioactivity in the Environment, Munich, 5-9 Jul. 1971
(Contract W-7405-eng-26)
(Y-DD-98; Conf-710705-1) Avail: NTIS

The utilization of automation and/or computerization to expedite results under routine and emergency conditions are discussed for air and removable surface contamination, gamma spectrometry, and environmental dosimetry for a criticality excursion. NSA

N72-11621# Oak Ridge National Lab., Tenn.
**RESPONSE FUNCTIONS FOR BONNER BALL NEUTRON DETECTORS**
R. E. Maerker, R. L. Williams, F. R. Mynatt, and N. M. Greene 18 Jun. 1971 30 p
(ORNL-TM-3451) Avail: NTIS

Response functions applicable to measurements conducted at the Tower Shielding Facility are presented for Bonner ball detectors consisting of polyethylene spheres surrounding BF3 proportional counters and covered on the outside by cadmium. Author (NSA)

N72-11622# Brookhaven National Lab., Upton, N.Y.
**INVESTIGATION OF LEFT-RIGHT ASYMMETRY IN COMPTON SCATTERING BY POLARIZED ELECTRONS**
V. M. Lobashov and L. M. Smotritskii May 1971 29 p refs Transl. into ENGLISH from the Russian
(BNL-TR-428) Avail: NTIS

The left-right asymmetry in Compton scattering of 0.2- to 0.4-MeV gamma rays by oriented electrons in ferromagnetic scatterers was measured. The large asymmetry arising from scattering by fairly thick scatterers and exceeding the calculated asymmetry by more than an order of magnitude, assuming that the quantum electrodynamics are valid, is shown to give rise to a double scattering of gamma rays. A linear dependence of the resulting asymmetry on the magnetic induction of the scatterer (i.e., on the degree of orientation of the electrons) was found, and its independence on the external magnetic field is shown. When the distance between two successive scatterings is increased to 3 to 5 mm, the asymmetry of double scattering practically disappears. Asymmetry also occurs if one of the scatterers is not a ferromagnet, provided the distance between the scatterers is less than 2 to 3 mm. A phenomenological model of the process giving rise to a left-right asymmetry is discussed. NSA

N72-11623# Purdue Univ., Lafayette, Ind.
**PRODUCTION OF POSITIVE KAON NEGATIVE KAON AND PROTON ANTIPROTON PAIRS IN FOUR BODY REACTIONS AT 13.1 GeV/c**
J. A. Gaidos, T. A. Mulera, C. R. Ezell, J. W. Lamsa, and R. B. Willmann [1970] 19 p refs Supported by AEC
(COO-1428-273) Avail: NTIS

Data in the channels pion(+) p yields pion(+) p K(+)K(-) and pion(+) p antiproton p at 13.1 GeV/c are presented; the delta(++)K(+)K(-) and p K(+)K*(890) subsamples are discussed in terms of a double-Regge model. No resonance structure at M(p antiproton p) = 3.755 GeV is observed. Author (NSA)

N72-11624# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
**IMPROVED AIR MONITOR IN A STANDARD NUCLEAR INSTRUMENT MODULE**
William J. Woodward Jun. 1971 15 p refs
(Contract AT(07-2)-1)
(DP-1260) Avail: NTIS

An instrument was developed for multichannel monitoring of airborne radioactive contaminants using scintillation detectors. Each channel is contained in a single-width nuclear instrument module (NIM), and consists of an amplifier, an integral discriminator, and a five-range count rate meter covering 0-300,000 counts/min. Up to ten monitoring channels and a high voltage power supply can be installed in any standard NIM bin. Author (NSA)

N72-11625# Tennessee Univ., Knoxville.
**ELECTRON PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION STUDIES OF COLOR CENTERS AND IMPURITY IONS IN KMgF3 AND MgF2 Ph.D. Thesis**
Joseph Thomas Lewis Jun. 1971 133 p refs Sponsored by AEC
(TID-25746) Avail: NTIS

The EPR F center in MgF2 has been identified utilizing both electron nuclear double resonance and EPR results. The EPR F center signal was also correlated with an optical absorption band at 260 nm by monitoring the growth of each with electron, gamma and neutron irradiation, and the behavior of each upon annealing and optical bleaching. The kinetics of the thermal reorientation and decay of the F(-)2 or sub VK, center in KMgF3 were studied using both EPR and optical absorption techniques after an optical orientation. The F(-)2 center was found to reorient at 95 K almost exclusively through an angle of 90 deg. with an activation energy of 0.26 eV. The decay of the F(-)2 center varied with temperature at approximately the same rate as the reorientation. Author (NSA)

N72-11626# Scientific Translation Service, Ann Arbor, Mich.
**SPECTRAL-ANGULAR CHARACTERISTICS OF AN ELECTRON BEAM IN IRRADIATION OF A TISSUE-EQUIVALENT MEDIUM**
A. M. Lyubomirov and D. B. Pozdneev [1971] 10 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 15, no. 7, 1970 p 63-69 Prepared for ORNL
(ORNL Order 34B-83481)
(ORNL-tr-2476; STS-10514; T82) Avail: NTIS

Various characteristics of electrons penetrating through water slabs were calculated by the Monte Carlo method. There are differential and integral energy spectra and penetration coefficients. The normal incidence of electrons with energies between 50 KeV and 10 MeV is discussed. Author

N72-11627# McElroy (Ralph) Co., Austin, Tex.
**SHORT-RANGE MOLECULAR INTERACTIONS IN THE SYSTEM H2 - H2: THEIR DEPENDENCE ON THE ORIENTATION AND INTERNAL GEOMETRY OF THE TWO SPECIES**
O. Tapia, G. Bessis, and S. Bratoz [1971] 12 p refs Transl. into ENGLISH from Intern. J. Quantum Chem. Symp., No. 4, 1971 p 289-297 Prepared for Los Alamos Sci. Lab.
(LA-tr-71-54) Avail: NTIS

The short-range interaction energy U sub SCF USCF of the system H2...H2 is analyzed within the SLF-LCAO theory with an extended basis set of Gaussian orbitals. After a preliminary study of the dependence of U sub SCF (H2...H2) on the intermolecular distance, the following are examined: (1) the variation of U sub SCF (H2...H2) as a function of the mutual orientation of the two molecules, (2) the variation of U sub SCF (H2...H2) as a function of the internal dimensions of the two interacting partners. The role of this kind of analysis in the study of vibration spectra in the liquid state is stressed. Author

N72-11628# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
**NUKLEONIKA, VOLUME 15, NO. 4**
1970 94 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 15, no. 4, 1970 p 317-416 Prepared for AEC and NSF
(AEC-tr-7102/4; TT-70-55010/4) Avail: NTIS

Papers are presented on nuclear physics, radiochemistry, applied nuclear technology, and reactor engineering and equipment. The following topics are included: nuclear radiation silicon detectors produced by ion implantation; mechanism of terpolymerization during radiolysis of grafting solutions; self-absorption of the Cerenkov light as a quantitative indicator of radiolysis progress; ion-molecule reactions in methylamine and methylamine-ammonia systems; electron microscopic autoradiography of synthetic fibers; radioisotope measurements of the flow parameters of the postflotation slurry; effect of injection speed on the tracer concentration curves; automatic supply system of the six-gap magnetic beta spectrometer; temperature measurements of fuel element cladding the EWA 10 reactor core; basic static parameters for WWR-SM lattices and estimation of heterogeneity effect on neutron age; and fast coincidence circuit of discrimination level-independent resolving time. N.E.N.

N72-11629# Los Alamos Scientific Lab., N.Mex.
**MONTE CARLO TRAJECTORIES: DYNAMICS OF THE REACTION H PLUS F2**
N. C. Blais Jul. 1971 10 p refs
(Contract W-7405-eng-36)
(LA-4687) Avail: NTIS

Approximately 10,000 trajectories were computed to simulate the reaction H + F2 yields HF + F. The interatomic forces were represented by the London equation and the appropriate Coulomb and exchange integrals evaluated using the Heitler-London formalism. Modifications of the theoretical 3 Sigma states of both HF and F2 were necessary to obtain the proper energy barrier. Trajectories were started at five preselected values of initial relative velocity. At each velocity the initial vibration of F2 was also preselected at v = 0 and v = 1. All other variables were chosen by Monte Carlo methods from appropriate distributions. The cross section for reaction increases monotonically from a threshold at a relative velocity between 3.6 and 4.0 X 10 to the fifth power cm/sec. An F2 molecule in the v = 1 state has a slightly larger cross section than if it is in the v = 0 state, but only at lower relative velocities. The product HF is excited to the vibrational level v = 5. Only a small variation in the vibrational distribution of HF is observed with initial energy and an increase in energy results in a lower average vibration of HF. Starting a trajectory in v(F2) = 1 reveals an artifact of the classical nature of the trajectory, but it shows a trend to give a product in a higher v state than if v(F2) = 0. A thermal averaging gives results of distributions in HF vibrations in agreement with experiment. Predictions about differential cross sections which can be observed in molecular beam experiments are included. Author

N72-11630# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
**ELECTRON TRANSMISSION THROUGH THICK PLANE SHIELDING: PROGRAM MONA 1 [TRANSMISSION DES ELECTRONS PAR LES ECRANS PLANS EPAIS: PROGRAMME MONA 1]**
J. Bourrieau May 1971 123 p refs In FRENCH
(ONERA-NT-02-24) Avail: NTIS

A method is proposed for the calculation of scattered and transmitted electron energy and angular distribution after impact with spacecraft shielding. The method consists of selecting only those points which are most sensitive to radiation and estimating the dose received. The original complex computer programs were broken down into simpler modules. The method is not suitable for the study of a complex situation such as a manned spacecraft, but for the simpler situations found currently in the French space program it shortens the time needed for such a

study. The program is also used to determine the energy of an electron beam used for the simulation of this distribution in an accelerator. ESRO

N72-11631# Melbourne Univ., Parkville (Australia). School of Physics.
**[BETATRON ANCILLARY EQUIPMENT AND EXPERIMENTAL DATA] Interim Report, 1 Aug. 1970 - 30 Apr. 1971**
B. M. Spicer Jun. 1971 16 p
(Grant DAHC 19-70-G-0026; DA Proj. 100-61102-B-11-B)
(AD-726976) Avail: NTIS CSCL 20/7

A report is provided on the state of the Melbourne betatron and ancillary equipment used on this effort. Progress is reported on' Precision measurements of (gamma,n) cross sections; Measurements of (gamma,np) cross sections; The electric quadrupole giant resonance; Photoproton energy and angular distributions; Electron beam experiments; Photoneutron spectra from light nuclei. Plans for future work in these areas are stated. Details of cost-sharing in the work by the University of Melbourne are specified. Author (GRA)

N72-11632# Oak Ridge Gaseous Diffusion Plant, Tenn.
**INTERNAL RAREFIED GAS FLOWS WITH BACKSCATTERING. PART 3: KRAMER'S PROBLEM: THE EFFECT OF BACKSCATTERING ON SLIP**
A. S. Berman (Minnesota Univ.) 16 Jun. 1971 7 p refs
(Contract W-7405-eng-26)
(K-1798-Pt-3) Avail: NTIS

The dependence of the slip coefficient on the probability of backscattering is computed. The calculation uses the Bhatnagar-Gross-Krook model to solve the Kramer problem with modified boundary condition. The slip coefficient is found to decrease monotonically with increasing backscattering. As an example, 6% backscattering reduces the slip coefficient by about 11% below that which would be computed for pure diffuse scattering at the solid surface. Author

N72-11633# Defense Documentation Center, Alexandria, Va.
**RADIATION DAMAGE, VOLUME 1 Report Bibliography, Jan. 1965 - May 1970**
Jun. 1971 235 p refs
(AD-724810; DDC-TAS-71-22-1-Vol-1) Avail: NTIS CSCL 07/5

The annotated bibliography has been compiled from the Defense Documentation Center's data bank holdings from January 1965 to January 1971 on Radiation Damage. These damages have been limited to changes in materials exposed to gamma rays, fission fragments, or neutrons. Also included are the corporate author-monitoring agency, subject, and title indexes. GRA

N72-11634# Aerospace Corp., El Segundo, Calif. Lab. Operations
**DIFFERENCE BAND CONTRIBUTIONS TO THE INFRARED EMISSION AT 2.7 MICRONS FROM FLOWING CO2 N2 MIXTURES Technical Report, Jul. 1970 - Feb. 1971**
Peter E. Oettinger 10 May 1971 28 p refs
(Contract F04701-70-C-0059)
(AD-725035; TR-0059(6220-01)-1; SAMSO-TR-71-112) Avail: NTIS CSCL 07/4

A flow tube has been constructed wherein ground-state CO2 and vibrationally excited N2 molecular streams interact and the combined flow is spectrally investigated at selected downstream stations. The close coupling between the lower vibrational levels of N2(X singlet Sigma(g)(-)) and the CO2 asymmetric stretch mode (00V3) allows rapid energy exchange to these levels, followed by internal redistribution among the vibrational states of the various CO modes. By monitoring the emission at the 2.7-micron band, it has been observed that such redistribution produces substantial population of the mixed-mode levels associated with this radiation. In addition, comparison of the observed band profiles with analytically derived counterparts has indicated that, for a N2 vibrational temperature of 1900C, CO2 difference bands at 2.7 micron contribute approximately 2.5 times as much radiant energy as is emitted in the 10 1-00 0 and 02 0-00 0 summation bands. Author (GRA)

N72-11635# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
**TABLES OF ENERGY AND ANGULAR DISTRIBUTIONS OF ELECTRONS EJECTED FROM SIMPLE GASES BY ELECTRON IMPACT**
C. B. Opal, E. C. Beaty, and W. K. Peterson 26 May 1971 124 p
(Contract DA-31-124-ARO(D)-139)
(AD-725483; JILA-108) Avail: NTIS CSCL 07/4

The normalized results of relative measurements of electron production cross sections differential in angle over the 30 to 150C range and in ejected energy over the 4 to 200 eV range are tabulated. Primary electron energies from 50 to 2000 eV were used in the study of He, N2, and O2. The remaining gases (Ne, Ar, Kr, Xe, H2, CH4, NH3, H2O, N2, C2H2, CO, NO, O2, and CO2) were studied under 500 eV impact. Measurements were performed in a crossed-beam apparatus with the use of a rotatable electron gun and a fixed hemispherical electrostatic energy analyzer. Author (GRA)

N72-11636# Systems Science and Software, La Jolla, Calif.
**A NUMERICAL TREATMENT OF SCATTERING AND FLUORESCENCE IN PLANE GEOMETRY Final Report**
Roland H. Fisher and R. A. Kruger May 1971 41 p refs
(Contracts DASA01-68-C-0072; DASA01-70-C-0055; DASA Proj. NWER XAXA)
(AD-725161; DASA-2418; Rept-3SR-119; NWER-Subtask-AA-108) Avail: NTIS CSCL 18/8

The model which is discussed in this report has been developed and programmed as an independent energy deposition and transport code, FSCATT. FSCATT represents a general and economical treatment of the effects of photoelectric absorption, fluorescence, and Compton scattering for problems in slab geometry. In the FSCATT program the intensity of the radiation field is computed in terms of finite angular and energy groups. The Klein-Nishina cross section is used and softening of the incident spectrum is permitted. Effects of polarization, inverse Compton scattering, and stimulated emission have been neglected. The results of calculations made using FSCATT and the Monte Carlo code PHOTRAN are compared in this report. Preliminary observations indicate that comparable results are obtained with substantially less computer time required using the FSCATT program. The scope of this report is limited to a discussion of the model and the presentation of some preliminary results. The FSCATT code will be documented in a subsequent report. Author (GRA)

N72-11742*# Translation Consultants, Ltd., Arlington, Va.
**THE PROBLEM OF THE THERMAL EXPLOSION IN A DEGENERATE GAS**
V. V. Porfiryev and Yu. N. Redkoborodyy *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 10-12 refs (See N72-11740 02-30)
Avail: NTIS CSCL 20H

## 25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N72-11637 National Lending Library for Science and Technology, Boston Spa (England).
**THE THERMAL PLASMA AS A STANDARD INTENSITY SOURCE IN THE WAVELENGTH RANGE FROM 1100 TO 3100 A**

G. Boldt 19 Aug. 1971 70 p refs Transl. into ENGLISH from German report MPI-PAE/Extraterr. 29, Jul. 1969
(NLL-CTO-762-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 7 NLL photocopy coupons

A standard intensity source is described consisting of a thermal argon plasma with small additives of hydrogen, nitrogen, and carbon dioxide. These gases are introduced in such a concentration to produce a series of optically thick spectral-lines in the region 1100 A to 3100 A. The intensity in an optically thick line center is given by the Kirchhoff-Planck-function which is determined if the plasma temperature is known. The continuous character of the function allows for interpolation between the spectral lines. At longer wave lengths above 1800 A only two carbon I-lines are found to be optically thick. Here the optically thin argon continuum is calibrated against the carbon I-lines and is used as an additional standard emission. By this procedure an absolute intensity scale is constructed at every wave length between 1100 A and 3100 A. The precision of the absolute intensities depends essentially on the precision of the temperature measurement for the plasma. Four different spectroscopic methods are used for this determination giving a temperature of 12540 K with an error of + or - 1% to + or - 2%. Author

N72-11638# Scientific Translation Service, Ann Arbor, Mich.
**NONLINEAR STAGE OF HYDROMAGNETIC CURRENT INSTABILITY OF PLASMA IN A STRONG ELECTRICAL FIELD**
V. L. Sizonenko and K. H. Stepanov [1971] 24 p refs Transl. into ENGLISH of Akad. Nauk Ukr. SSR, Fiz. -Tekhn. Inst., Khakov, report KhFti-70-45 Prepared for ORNL
(ORNL Order 34B-83481)
(ORNL-TR-2434; KhFTI-70-45; T73) Avail: NTIS

The development of a hydromagnetic Bunemanovsk current plasma instability is studied in a strong electric field in which electrons acquire a velocity significantly greater than their thermal velocity. The electric field is assumed to be more powerful than a Dreiser field and a certain critical field E sub zero. The yield for the nonlinear stage of current instability in the one-dimensional case is examined, for which the electrons move only along the external magnetic field parallel to the vector E sub zero. NSA

N72-11639# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Technische Physik.
**APPLIED MAGNETOHYDRODYNAMICS. NO. 7: ELECTRICAL LOSSES IN THE MHD GENERATOR [ANGEWANDTE MAGNETOHYDRODYNAMIK. HEFT 7: UBER ELEKTRISCHE VERLUSTE IM MHD-GENERATOR]**
Christian Holzapfel Mar. 1971 65 p refs In GERMAN; ENGLISH summary
(JUL-742-TP) Avail: AEC Depository Library

By separation of the flow system in an MHD generator into boundary layer and bulk, a simple model of the electrical conditions in the bulk flow of the generator is set up. With this model, the influence of the reductions of the Hall field on the other parameters in the generator is described by use of a generalized characteristic. With increasing magnetic field, a saturation of the Faraday voltage appears. The calculation shows that this saturation appears in the lower region of the magnetic field where no electrothermal instabilities appear. At higher magnetic fields with electrothermal instabilities, the Faraday voltage increases again with increasing magnetic field. Moreover, there exists a lower limit of the velocity below which no nonequilibrium ionization appears if the resistance in the diffusor due to which the Hall field is reduced is too low. On the other hand, there exists an upper limit of the velocity in the subsonic case in a generator with constant cross section above which the Mach number increases to the value 1 due to the energy conversion in the generator. Author (NSA)

N72-11640# Columbia Univ., New York. Plasma Lab.
**NUMERICAL SIMULATION OF STRONG PLASMA SHOCK WAVES PRODUCED IN AN ELECTROMAGNETIC SHOCK TUBE Ph.D. Thesis**
Stephen Henry Schneider 1971 112 p refs
(Contract AT(30-1)-3954)
(CU-3954-9; Rept-55) Avail: NTIS

Two different continuum fluid models were used to study numerically plasma shock-wave formation and structure in an electromagnetic shock tube. Magnetohydrodynamic equations with numerical dissipation were used to study qualitatively the important effects of diffusion and dissipation. A set of two-fluid Navier-Stokes equations with physical transport coefficients was then used to compute the detailed evolution and structure of these waves in a strong transverse bias magnetic field. The field significantly reduces the thermal conductivity so that the upstream diffusion of electron temperature is entirely suppressed. The whole structure is different from that of a two-fluid gas dynamic shock without transverse magnetic field. Especially signficant is the effect of the small ion Larmor radius in reducing the gas dynamic shock thickness by at least an order of magnitude in the transverse shock, which permits collisional shocks with thickness much smaller than a mean free path to be produced in a laboratory-sized device. Author (NSA)

N72-11641# Princeton Univ., N.J. Plasma Physics Lab.
**CONSIDERATION OF POWER REQUIREMENT IN FUSION FEASIBILITY EXPERIMENT**
S. Yoshikawa Jun. 1971 17 p refs
(Contract AT(30-1)-1238)
(MATT-803) Avail: NTIS

Assuming that pseudoclassical diffusion theory holds to the reactor condition, the estimate of power requirement of plasma heating in self-sustaining toroidal fusion devices is made. It is found that various heating methods such as neutral beam injection, rf heating, etc., are reasonably competitive from the power requirement except for the relativistic electron beam injection, which may be financially too difficult. The advantage of the astronspherator combination was noted. Author (NSA)

N72-11642# University of Southern Calif., Los Angeles. Dept of Physics.
**MEASUREMENT OF THE PHOTOIONIZATION CROSS SECTION IN THE RESONANCE CONTINUUM OF CARBON-I Final Report, Mar. 1968 - Nov. 1970**
Walter Hofmann and G. L. Weissler Jan. 1971 58 p refs
(Contract F33615-68-C-1228; AF Proj. T073-00-01)
(AD-725058; USC-VACUV-121; ARL-71-0001; DOD-Element-61102F; DOD-Subelement-681301) Avail: NTIS CSCL 07/4

A wall-stabilized high-current (100 A) arc was operated in argon at a pressure of one atmosphere, and critical plasma properties such as temperature, electron-, ion-, and atom-densities have been determined by spectroscopic observations in the visible and in the vacuum ultraviolet regions of the spectrum, assuming local thermal equilibrium. By adding CO2 gas to the argon, the density of carbon atoms in the plasma could be measured. These values, together with the arc emission intensities in the vacuum uv region between 980A and 1250A, provided sufficient data to allow the calculation of the photoionization cross section of carbon. This experimental value compared well with those theoretical calculations which have been previously published. Author (GRA)

N72-11643# California Univ., Los Angeles. School of Engineering and Applied Science.
**ACCURACY IN APPROXIMATIONS TO THE TIME DEVELOPMENT SOLUTION OF THE VLASOV EQUATION**
W. A. Janos Jun. 1971 5 p refs
(Grant AF-AFOSR-1547-68; AF Proj. 9749)
(AD-725771; AFOSR-71-1815TR) Avail: NTIS CSCL 20/9

The paper concerns the establishment of functional bounds on the error in approximating the solution to the Vlasov equation for a one component plasma in the presence of external fields. The approximate solution is the time development of the initial distribution along trajectories described entirely by the external

fields. Thus the error is due to the nonlinear self-field effect which modifies the simple trajectories. An indication of the required conditions for close approximation to the true solution is established for the case of slowly varying external electromagnetic fields. Author (GRA)

N72-11644# Wisconsin Univ., Madison. Mathematics Research Center.
**ASYMPTOTIC THEORY OF NONLINEAR WAVE MOTIONS IN MAGNETOHYDRODYNAMICS. PART 2: INTERNAL WAVES**
M. C. Shen Aug. 1970 34 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-725085; MRC-TSR-1095) Avail: NTIS CSCL 20/9

Asymptotic nonlinear wave motions of a conducting fluid confined between two fixed horizontal planes are studied. Wave speeds and evolution equations, which depend upon the direction of wave propagation, are determined. An exceptional case is considered to illustrate the asymptotic method. Author (GRA)

N72-11645# California Univ., Berkeley.
**THEORY OF PLASMA KINETICS, SCATTERING OF ELECTROMAGNETIC WAVES BY PLASMAS, AND THE DYNAMICS OF PARTICLES AND ATOMS**
Kenneth M. Watson and Stanley Mandestam 26 Apr. 1971 14 p refs
(Contract F44620-70-C-0028; Proj. AF-9751)
(AD-725772; AFOSR-71-1820TR) Avail: NTIS CSCL 07/4

A summary is given of work performed during the last year. The chief topics were: Atomic Physics (Eikonal approximation, Transport equations, air ionization by laser beams); Plasma Physics (Resonance broadening, quasilinear theory, interaction between particles and normal modes, electromagnetic plasma simulation); Elementary-Particle Physics (Veneziano Model, including unitarization program and models with fermions, multi-peripheral models, current algebra, weak interactions, quantum electrodynamics, field theory). Author (GRA)

# 26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-11646 National Lending Library for Science and Technology, Boston Spa (England).
**PROBLEMS OF WIRELESS CONTACTING**
V. Winkler 22 Sep. 1971 3 p Transl. into ENGLISH from Nachrichtentechnik, Elektronik (East Germany), v. 20, no. 12, 1970 p 453-454
(NLL-PORS-Trans-2780-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Flip-chip techniques, beam-lead techniques, and spider-bond techniques are discussed as methods for wireless contacting of semiconductor components in switching circuits. It is shown that all these methods have advantages and disadvantages in manufacturing processes. Flip-chip production requires little space on the semiconductor wafer and achieves a high bonding strength; however, no visual observation of the chip surface is possible during contacting. The beam-lead procedure requires gold and expensive technological production steps as well as more space on the semiconductor wafer and induces silicon losses. G.G.

N72-11647# National Lending Library for Science and Technology, Boston Spa (England).
**DISSOCIATIVE INSTABILITY IN CRYSTAL LATTICES AT HIGH TEMPERATURES [O DISSOTSIATIVNOI NEUSTOICHIVOSTI KRISTALLICHESKOI RESHETKI PRI VYSOKIKH (TEMPERATURAKH)]**
A. E. Glauberman and A. M. Muzychuk Aug. 1971 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 14, no. 11, 1969 p 1831-1836
(NLL-RTS-6674) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.90 or 3 NLL photocopy coupons

The mechanism of quasi-steady thermal point defects in crystals, based on cell excitation, is examined. Attempts were made to define a simple model, assuming that gaps and atoms between lattice points are formed in varying quantities as a result of lattice point dissociation. The expanded lattice, consisting of regular points and interstices, is also considered. Results indicate the method could enable a fuller description of disordering in crystal atoms as temperature rises and volume increases, and a treatment of melting closer to reality, including a reasonable description of the phase change. Author

N72-11648 National Lending Library for Science and Technology, Boston Spa (England).
**A METHOD FOR THE LAYER MASS SPECTRAL ANALYSIS OF THIN SEMICONDUCTOR FILMS**
M. S. Chupakhin and G. I. Ramendik 1 Jun. 1971 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. SSSR (Moscow), v. 184, no. 6, 1969 p 1372-1375
(NLL-NSTIC-Trans-2235-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The development of a method for layer-mass spectral analysis of semiconductor materials is discussed. In layer analysis the most valuable information is data concerning the distribution of admixtures in the volume of the sample analyzed. These are tracked over the whole depth by means of a comparison of suitable exposures on a photographic plate. A comparison of layers among themselves makes it possible to trace the regularity of change in the content of admixtures, taking advantage of the high reproducibility of results which can be obtained by spark-source mass spectrometry. Author

N72-11649 National Lending Library for Science and Technology, Boston Spa (England).
**DIFFUSION OF IMPURITIES FROM THE GAS STREAM IN EPITAXIAL LAYERS OF GaP GROWN BY THE SENDOVITCH METHOD**
L. I. Dyakonov and V. N. Maslov 1 Jun. 1971 10 p refs Transl. into ENGLISH from Neorgan Materiali, v. 3, no. 7, 1967 p 1147-1151
(NLL-NSTIC-Trans-2037-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The character of the diffusion of alloying or contaminating impurities and their effect on the properties of single crystals grown in a gas stream are discussed. It is noted that during the growth of single crystals of gallium phosphide, a large quantity of arsenic can fall onto the epitaxial layer from the secondary process of corrosion of the side surface of the linings in the gas stream. The electrical and optical properties of the single crystals are principally affected by the impurities. Author

N72-11650 Washington Univ., Seattle.
**MEASUREMENT OF LOW-LEVEL IONIZATION PHENOMENA IN FIELD EFFECT TRANSISTORS** Ph.D. Thesis
William Erven Sayle 1970 113 p
Avail: Univ. Microfilms Order No. 70-19654

Ionization rates in semiconductors can be measured at low values of electric field using a new method involving a field-effect transistor (FET) structure which offers greater sensitivity than reverse biased p-n junction diode methods. Carriers of only one polarity cause ionization in the FET and no correction is required for ionization caused by carriers of the opposite polarity. Very small ionization currents can be detected because secondary carriers resulting from ionization are attracted to a different terminal (gate or substrate) than the one used to collect the primary carriers (drain). Values of electron ionization rate and hole ionization rate are obtained for silicon. Analytical determination of electric field is provided by a solution of

Poisson's equation for the field effect structure. Difficulty in accurately determining the FET channel doping introduces a 30 percent uncertainty in electric field values. Dissert. Abstr.

N72-11651 Washington Univ., Seattle.
**PROPERTIES OF HEAVILY DOPED N-TYPE GALLIUM ARSENIDE Ph.D. Thesis**
Emsley Henry Stevens 1970 333 p
Avail: Univ. Microfilms Order No. 70-19661

Generalized expressions for the relaxation times due to impurity and polar-optical phonon scattering are derived. The relaxation times account for electron screening and nonparabolic conduction band structures. A treatment of electron-electron scattering is developed. Theoretical mobility calculations, using the generalized relaxation times, are shown to be in quantitative agreement with experimental Hall effect data. The results of a study of infrared absorption in heavily doped, n-type gallium arsenide are described. Absorption measurements are used to determine a value for the energy splitting between the gamma-1 and X-1 conduction band valleys, which is found to be 0.43 + or - 0.02 eV. It is shown that an electron-phonon interaction is involved in the intervalley absorption processes. The energy of the phonon active in the processes is estimated to be 0.03 eV from an analysis of experimental data on infrared absorption versus temperature. Dissert. Abstr.

N72-11652*# Translation Consultants, Ltd., Arlington, Va.
**THE DEMBER EFFECT IN AN INHOMOGENEOUS SEMICONDUCTOR AND THE BULK PHOTOVOLTAIC EFFECT [EFEKT DEMBERA W POLPRZEWODNIKU NIEJEDNORODNYM I OBJECTOSCIOWY EFEKT FOTOWOLTAICNY]**
S. Sikorski Washington NASA Nov. 1971 27 p refs Transl. into ENGLISH from Arch. Elektrotech. (Warsaw), v. 15, no. 4, 1966 p 703-723
(Contract NASw-2038)
(NASA-TT-F-14009) Avail: NTIS CSCL 20L

An expression for the current density in an illuminated inhomogeneous semiconductor is derived. The expression is reduced to a form that makes it suitable for the analysis of the Dember effect and the bulk photovoltaic effect. The problem of measuring the potential in an excited semiconductor is examined, and an energy balance is performed. Author

N72-11653*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LIGHT REGULATOR Patent Application**
Jerry G. Williams and Joseph G. Judd, inventors (to NASA) Filed 28 Apr. 1971 8 p
(NASA-Case-LAR-10836-1; US-Patent-Appl-SN-138227) Avail: NTIS CSCL 20L

A thin absorbing metallic film deposited on a low-modulus transparent substrate and a mechanism for stretching the substrate are described. As the substrate is stretched, the thickness of the thin film decreases and microfractures occur, thereby allowing an increase in transmission of visible light through the thin film. NASA

N72-11654# California Inst. of Tech., Pasadena. Keck (W. M.) Lab. of Engineering Materials.
**MOESSBAUER EFFECT STUDY OF AMORPHOUS Fe-Pd-Si ALLOYS**
T. E. Sharon and C. C. Tsuei Jul. 1971 12 p refs
(Contract AT(04-3)-822)
(CALT-822-32) Avail: NTIS

The Mossbauer spectra of amorphous Fe(x)Pd(80-x)Si20 alloys (0 < x < or approximately = 7) obtained by rapid quenching from the liquid state were measured at 4.2 k, 77 k, and 295 k. The results are not typical of a superparamagnetic system, as had been suggested earlier on the basis of magnetization measurements. A model proposed for the magnetism in these alloys based on a local ferromagnetic order whose direction changes continuously throughout the material. The apparent disappearance the quadrupole interaction below the transition temperature is explained. Author

N72-11655# Oak Ridge National Lab., Tenn.
**RESEARCH MATERIALS INFORMATION CENTER BULLETIN AND STATUS REPORT**
T. F. Connolly Apr. 1971 42 p refs
(Contract W-7405-eng-26)
(ORNL-RMIC-11) Avail: NTIS

Inorganic materials for which references on crystal growth can be provided and materials for which on crystal suppliers or adequate growth methods could be found are listed. Information centers, directories, and new serials and journals in the area of of solid state materials science are included, along with bibliographies published or in press. Author

N72-11656# Oak Ridge National Lab., Tenn.
**EFFECT OF HEAT TREATMENT AND IMPURITIES ON THE CURRENT DENSITY OF TRANSITION METAL SUPERCONDUCTORS**
D. S. Easton, J. O. Scarbrough, and J. O. Betterton, Jr. Jun. 1971 35 p refs
(Contract W-7405-eng-26)
(ORNL-4703; UC-25) Avail: NTIS

The critical current densities of alloys of Zr-Nb, Ti-Nb, and Hf-Nb were increased by the addition of interstitial impurities and by heat treatments to produce precipitation. The alloy Zr 50% Ta was found to be a good high-field superconductor. Differences in the preparation and heat treatment of the alloys greatly affected the final critical current density. High-purity alloys prepared in an ultrahigh-vacuum zone refiner had lower critical current densities than those prepared by the usual arc melting techniques. Electrical resistivity measurements made at 300 and 77 K are included in the Appendix along with critical current density values of the alloys prepared for this work.
Author (NSA)

N72-11657# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Phys.
**VALIDITY OF THE BOLTZMANN EQUATION FOR SYSTEMS WITH BOTH ELECTRON-PHONON AND IMPURITY SCATTERING**
Bernie G. Nickel and John W. Wilkins Jun. 1971 9 p refs
(Contract AT(30-1)-3699)
(NYO-3699-56) Avail: NTIS

A recent calculation of Mills indicating large deviations from Mathiessen's rule are shown to be in error because of the neglect of terms of the same order in perturbation theory which remove the reported divergency and leave only very small corrections to the Boltzmann equation. In addition it is suggested that the experimental basis for these large deviations may be capable of a different explanation. Author

N72-11658# Yale Univ., New Haven, Conn. Becton Center.
**ON THE USE OF PARAMETERS IN CRYSTAL FIELD THEORY AND RELATED CALCULATIONS**
W. P. Wolf [1970] 11 p refs Sponsored by AEC
(YALE-3227-77) Avail: NTIS

General criteria for the use of empirical parameters as an alternative to detailed first principle calculations of complex many electron problems are discussed. It is suggested that whenever useful theoretical accuracy cannot be obtained, the experimental data are more meaningfully analyzed in terms of empirically fitted parameters, using the theory only for establishing the correct form of the Hamiltonian and predicting which parameters may safely be neglected. The application of these criteria is illustrated for the case of crystal field theory.
Author

N72-11659# Chicago Univ., Ill.
**EXPERIMENTAL INVESTIGATION OF THE FERMI SURFACES OF METAL Final Report, 25 Jun. 1967 - 24 Dec. 1970**
Royal W. Stark 1971 12 p refs
(Grant DA-ARO(D)-31-124-G926; DA Proj. 200-61102-B-32-D)
(AD-724811; AROD-4596-18-P) Avail: NTIS CSCL 20/12

The work described in this report was aimed primarily at understanding the characteristics of the conduction electron states at the Fermi surface of metals. In particular, during this grant period the author has performed various studies of the metals beryllium, magnesium, zinc, cadmium, white tin, nickel, iron, and calcium. The author has completed extensive redesign and construction of experimental apparatus which allows one to measure signals as small as 0.003 micromicrovolts at temperatures as low as 0.02K in magnetic fields as high as 59 KG. The author has used some of the low temperature apparatus to study the properties of positive and negative ions in liquid He4 in the range of temperatures from about 0.28 degree K to 1.0 degree K. Author (GRA)

N72-11660# Paris Univ. (France). Lab. de Physique des Solides.
**PHOTON-PHONON INTERACTION IN RADIATIVE RECOMBINATION BY THE IMPURITY CENTER IN ZnS:Mn Interim Report**
R. Berseman and M. Balkanski Jun. 1971 28 p refs
(Contract AF-EOAR-0016-68; AF Proj. 7865)
(AD-725077; ARL-71-0091; SR-13) Avail: NTIS CSCL 20/12

Analysis of light emission spectra obtained by cathodoluminescence shows a phonon assisted process. In order to determine the nature of the participating phonon, light scattering experiments are presented. The results show clearly that the phonon participating in the radiative recombination in ZnS:Mn is the resonant impurity breathing mode whose frequency is 297 reciprocal cm. Author (GRA)

N72-11661# Technion - Israel Inst. of Tech., Haifa.
**ELECTRICAL PROPERTIES OF TRANSITION METAL OXIDES UP TO 1600 C Final Report, 1 Aug. 1964 - 30 Apr. 1970**
D. S. Tannhauser Wright-Patterson AFB, Ohio ARL Feb. 1971 63 p refs
(Contract AF 61(052)-825; AF Proj. 7021)
(AD-725064; ARL-71-0021) Avail: NTIS CSCL 20/12

Properties of atomic defects and of charge carriers in the following materials were determined: MnO, FeO, CoO, and NiO. Most of the measurements were made on undoped material under high temperature equilibrium conditions with the lower limit of temperature being 900C, and the upper limit being 1500C or even 1700C in the case of MnO. The oxygen pressure extended from pure oxygen to 10 to the minus 20th power atm of oxygen. Properties measured or calculated from the measurements were: deviation from stoichiometry, conductivity, thermopower, Hall mobility and drift mobility of electrons and holes, concentrations of ionized and non-ionized defects. Additional results include parts of the phase diagram of the above compounds. For CoO measurements were also made on chemically doped materials. In the case of FeO and CoO the author has made measurements of electrical properties in the vicinity of room temperature and down to liquid air temperature. In NiO the author has measured the photoconductive response in the near infrared, the visible and the ultraviolet. Materials used were single crystals and polycrystals, depending on availability and on the experimental conditions. Single crystals of NiO and FeO were grown in this laboratory by an epitaxial method. Author (GRA)

N72-11662# Princeton Univ., N.J. Dept. of Electrical Engineering.
**SORPTION INDUCED CONDUCTIVITY CHANGES IN COMPOUND SEMICONDUCTORS Ph.D. Thesis. Technical Report, Sep. 1969 - Jun. 1971**
Suprasad Baidyaroy and Peter Mark Jun. 1971 33 p refs
(Contract N00014-67-A-0151-0014; NR Proj. 056-492)
(AD-725177; TR-9) Avail: NTIS CSCL 20/12

Large changes in the equilibrium semiconductivity of thin compound semiconductors induced by chemisorption are investigated. Evaporated films and single crystals of CdS and single crystals of CdSe (both n-type) show a gradual reduction in semiconductivity coupled with an increase in activation energy with increasing oxygen pressure above a certain threshold. Evaporated CdS films are more sensitive to such changes at lower pressure as are the more highly compensated Cu and Au doped films. Oxygen chemisorption states of CdS and CdSe are distributed in energy in the semiconductor bandgap being largest at the conduction band edge and decreasing exponentially with energy into the gap. Atomically structured CdS single crystal surfaces, obtained by ion bombardment and vacuum annealing are insensitive to chemisorption. Thus, adsorption sites can be associated with surface impurities and/or imperfections. PbI2 (p-type) exhibits an increase in semiconductivity with oxygen pressure in accord with the models developed in the report. Author (GRA)

N72-11663# Carnegie-Mellon Univ., Pittsburgh, Pa.
**LOW TEMPERATURE HEAT CAPACITY OF THE META-MAGNET Ni(NO3)2-2H2O**
L. G. Polgar and S. A. Friedberg 15 May 1971 18 p refs
(Contract N00014-67-A-0314-0006; NR Proj. 018-301)
(AD-725169; TR-4) Avail: NTIS CSCL 20/12

The heat capacity C sub P of Ni(NO3)2.2H2O has been measured in the range 1.5 = or < T = or < 10K revealing a sharp lambda-anomaly, characteristic of the transition to a magnetically ordered state, at T sub N = 4.105 plus or minus 0.005K. The magnetic contribution to C sub P has been separated from the lattice part and the temperature variation of the magnetic entropy calculated. The magnetic entropy at T sub N is found to be only 0.546R suggesting a two-dimensional character to the ordering which is compatible with the picture of this system as an antiferromagnetically coupled array of alternating sheets of ferromagnetically aligned Ni(++) spins. This interpretation, however, is complicated by the effect of anisotropy on C sub P. Author (GRA)

N72-11664# Defense Documentation Center, Alexandria, Va.
**RAMAN SPECTROSCOPY Bibliography Report, Apr. 1960 - Feb. 1971**
Jun. 1971 447 p refs
(AD-725700; DDC-TAS-71-27) Avail: NTIS CSCL 07/4

The annotated bibliography on Raman Spectroscopy has been compiled from the Defense Documentation Center's collection. Included are title and subject indexes. Author (GRA)

N72-11665# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
**RADIATION EFFECTS ON QUARTZ CRYSTALS AND OSCILLATORS, AND GROWTH OF DOPED QUARTZ CRYSTALS Annual Scientific Report, 1 Dec. 1969 - 30 Nov. 1970**
Abraham Halperin, Michael Schieber, Abraham A. Braner, David Zloto, and Josef Shapira Dec. 1970 45 p refs
(Contract F61052-69-C-0015; AF Proj. 5620)
(AD-725770; PDO-270; AFCRL-71-0275; Task-562008) Avail: NTIS CSCL 20/2

Quartz crystals were grown by the hydrothermal method in NaOH solutions. Rates of growth in the AT and Z directions were measured for undoped and doped quartz (Mg(2&), Ga(3&), V(5&)), using various temperature gradients. All dopants, except Mg(2&), gave rates of growth lower than undoped quartz. Oscillators made of various synthetic and natural Brazilian crystals were irradiated with 5 MeV electrons and effects of irradiation on frequency and on Q-values were measured over the temperature range 77-550 degrees K. Frequency changes and reductions in Q appeared at various temperature ranges. For a High-Q SARP crystal (5 MHz in 5th harmonic) the frequency change by irradiation with about 1,000,000 rads

reached about 700 Hz, and appeared mainly below 200 degrees K, just where the strongest thermoluminescence appeared. With the same crystal Q-values at a few temperature ranges were found to be sensitive to irradiation, and in these ranges the crystal even ceased oscillating after irradiation. Most effects of irradiation were canceled by heating to about 500 degrees K. Other crystals exhibited similar radiation effects. Author (GRA)

N72-11666# Northwestern Univ., Evanston, Ill.
**ON THE ISING MODEL WITH LONG RANGE INTERACTION 3: A RIGOROUS LOWER BOUND OF THE FREE ENERGY**
Arnold J. F. Siegert 3 Jun. 1971 15 p refs
(Contract N00014-67-A-0356-0002; NR Proj. 013-309)
(AD-725160; TR-2-6) Avail: NTIS CSCL 20/12

In the Weiss theory of ferromagnetism the interaction between the elementary magnets is replaced by a properly chosen spacially homogeneous field. It is known that the results of the Weiss theory applied to Ising models become exact in the limit of infinitely weak ferromagnetic interaction of infinite range, provided certain conditions hold. Even before the result had been rigorously proved, Brout started a program of finding correction terms to the Weiss theory for small values of a parameter gamma, defined so that the interaction energy of a pair of spins is proportional to gamma, and the range of interaction is Gamma to the power (-1/D), where D is the dimensionality of the lattice. The complete expansion of the free energy in a series, in which the dominant order in gamma of each term is easily obtained, was given in part I of the present paper for any fixed temperature T = Tw, where Tw is the Curie temperature of the Weiss theory. In part 2 it was shown that these results can be obtained by a resummation of the most divergent terms of the original expansion, if a certain integral diverges no worse than logarithmically at Tw. Convergence properties of these expansions are known only for the one dimensional model with exponential interaction, which has been solved exactly. In the present paper the author obtains a rigorous lower bound for the free energy, to supplement the known upper bound. Author (GRA)

N72-11667# Stanford Univ., Calif.
**INVESTIGATION OF THE SUPERCONDUCTING STATE BY ELECTRON MIRROR MICROSCOPY Final Report, 3 Nov. 1966 - 2 Jan. 1971**
William A. Little 1971 13 p
(Contract DAHC04-67-C-0014)
(AD-725592; AROD-8746.1-P) Avail: NTIS CSCL 20/12

The possibility of using an electron mirror microscope to study the nature of the superconducting state and the vortex pinning sites was investigated under the above contract. A cryogenic mirror microscope was first designed and built. Using this microscope, studies were made of specimens of Sn, Pb, and Nb. In view of the marked difference in resolution of magnetic and electric images, a study of the theory of image formation in the mirror microscope was undertaken. It was found that the effect of a spread in the energy of the incident electron beam had been ignored. An analysis of this problem indicated that a marked improvement in the magnetic and electrostatic resolution should be possible using a highly mono-energetic electron beam. Author (GRA)

# 27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-11668# Advisory Group for Aerospace Research and Development, Paris (France).
**AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY**
Aug. 1971 401 p refs Presented at 37th Meeting of the AGARD Propulsion and Energetics Panel, The Hague, 10-14 May 1971
(AGARD-CP-84-71) Avail: NTIS HC $6.00/MF $0.95

Papers are presented on aircraft fuels, their production, analysis, and testing. Fuel handling, fuel and fire safety, and lubricants are also discussed, using impact tests and crash simulations. For individual titles, see N72-11669 through N72-11701.

N72-11669# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
**JET FUEL SPECIFICATIONS**
L. Gardner and R. B. Whyte *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Various military and civil jet fuel specifications are compared and their differences noted, particularly with reference to different types of additives which are used on a mandatory or optional basis. Specification test procedures and their importance in relation to limits are discussed and the increased complexity of quality control for jet fuel specifications is noted. Author

N72-11670# France. Service Technique de l'Aeronautique, Paris.
**AERONAUTICAL SIGNIFICANCE OF POLYCYCLIC SATURATED HYDROCARBONS [INTERET AERONAUTIQUE DES HYDROCARBURES POLYCYCLIQUES SATURES]**
G. Verdie *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs In FRENCH (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The range of an airplane depends on the amount of energy used. When reservoir capacity is too limited, it is possible to extend the range by using a higher energy fuel. In this sense, high energy polycyclic saturated hydrocarbons are possible fuels for supersonic aeronautics in the near future, especially since their thermal stability is superior to that of present fuels. Essential fuel characteristics are presented together with the results of experimentation. Industrial fabrication problems and future perspectives are considered. Transl. by K.P.D.

N72-11671# Shell Research, Ltd., Chester (England). Thornton Research Centre.
**FUELS FOR SUPERSONIC AND HYPERSONIC AIRCRAFT**
A. Lewis, H. Strawson, and J. G. Kirtley *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs Sponsored in part by Min. of Aviation Supply (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The first generation of supersonic aircraft is being designed to operate on existing kerosene-type fuels. The limitations of these fuels are reviewed and possiblities considered for propellants for higher-speed aircraft, serving the triple purpose of cooling the airframe, cooling engine components, and providing propulsive energy. Problems of vapor deposition in hot fuel systems are covered and the possibilities explored of increasing the cold-sink value of the fuel by precooling or by endothermic decomposition. The calorific values of different fuels and the importance of recombination of dissociated combustion products is stressed. Ways of speeding such recombination are indicated. Author

N72-11672# Shell Development Co., Emeryville, Calif.
**COOLING OF ADVANCED ENGINES BY ENDOTHERMIC REACTIONS OF HYDROCARBON FUELS** c33
L. E. Faith, G. H. Ackerman, and H. T. Henderson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs Sponsored by AFAPL (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The fuel used in an engine is a convenient coolant, absorbing heat as sensible heat and latent heat of vaporization. Certain hydrocarbon fuels can furnish additional heat sink in the

form of endothermic reactions. Possible endothermic reactions include thermal reactions such as cracking, and catalytic reactions such as dehydrogenation, dehydrocyclization, and depolymerization. Of these, the catalytic dehydrogenation of naphthenes to aromatics is the most promising type of reaction. For example, the dehydrogenation of methylcyclohexane over platinum/alumina catalyst furnishes a reaction heat sink of approximately 1000 Btu/lb fuel, which is slightly greater than the cooling capacity due solely to sensible heat and latent heat of vaporization. This reaction is very selective and proceeds rapidly to achieve high conversion of methylcyclohexane to toluene and hydrogen. The total heat sink for such a reaction system compares favorably with that of hydrogen, when these heat sinks are normalized by the heat of combustion of the fuel. Author

N72-11673# Monsanto Research Corp., Dayton, Ohio.
**APPLICATION OF ANALYTICAL TECHNIQUES FOR THE ANALYSIS OF ADDITIVES AND CONTAMINANTS IN ADVANCED HYDROCARBON FUELS**
W. G. Scribner *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 7 p refs (See N72-11668 02-27)
(Contract F33615-69-C-1325)
Avail: NTIS HC $6.00/MF $0.95

A rapid method based on a specific ion electrode technique was adapted and verified for the determination of micrograms/g quantities in fuel of a fluorine-containing additive. A measurement method for ng/g levels of lead in hydrocarbon fuels is described, and the noninterference of allowed fuel additives is demonstrated. Examples are also cited where polar compound contaminants at the microgram/g level were isolated and identified by a combination of column chromatography and infrared spectrophotometry. Various factors which must be considered in method adaptation are reviewed, and the need for close communication between the fuel handling engineer and the analyst to expedite the solution of fuel contamination problems is stressed. Author

N72-11674# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.
**THE POSSIBILITIES OF ACTUALLY TESTING THE COMBUSTION CHARACTERISTICS OF AVIATION FUELS WITH APPROPRIATE EQUIPMENT**
H. Gemperlein *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Small-scale combustion chamber rigs are described, with which combustion characteristics of aviation fuels are being tested. The relationship of the chemical constitution of the fuels and their chemical-physical properties, and the processes during preparation and combustion of fuel is determined. Investigation is conducted at different air and fuel temperatures and at differently high pressures in the combustion chamber in a parallel flow. Temporally consecutive processes during fuel preparation and combustion may also be specially separated and thereby provide for a measurement with customary probes as well as spectroscopic methods. Author

N72-11675# Pisa Univ. (Italy). Lab. Prova Combustibili.
**LOW EMISSION FUELS AND DEVICES FOR AVIATION ENGINES**
G. Nardi *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Reduction of harmful emissions of turbine engine exhaust system is reviewed. The type of fuel used, combustion chambers, and operating conditions of combustors are also investigated. Author

N72-11676# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
**FUEL CLEANLINESS**
L. Gardner *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Dual purpose filter/separators were developed which could remove both dirt and water. Improvements in the performance of filter/separators was achieved by compliance with increasingly severe specifications. Methods of determining undissolved water and dirt in fuel and their development both for filter/separator testing and field use are discussed. Fuel contamination by microorganisms and surfactants has led to serious cases of aircraft corrosion and filter plugging. Measures to control or eliminate these two contaminants are discussed. Author

N72-11677# Lucas Gas Turbine Equipment, Ltd., Burnley (England).
**FUEL RELATED PROBLEMS IN AIRCRAFT FUEL SYSTEMS**
S. L. Forgham and R. G. Beckett *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 14 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Aircraft fuel problems are discussed, emphasizing problems associated with hydrogen treated fuels. Some of the problems were overcome by fuel system design modification, and other changes are reviewed which were instituted by refinery industries. Research on fuel sealing is also described. J.A.M.

N72-11678# BP Trading Ltd., London (England).
**AIRCRAFT FUELLING OPERATIONS AND QUALITY CONTROL**
G. R. Parker *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Aviation fuelling facilities and the fuelling operation are described. Comments on the types of aircraft are restricted to those aspects directly affecting fuelling. Author

N72-11679# Esso Development Co., Ltd., Abingdon (England). Research Centre.
**AVIATION FUEL LUBRICITY**
R. A. Vere *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

A laboratory test rig was developed to evaluate European jet fuels with regard to lubricity. This has shown differences in the lubricity levels of different fuels. Active lubricity agents were identified as fully saturated heterocyclic compounds and polynuclear aromatics. The addition of a surface active additive such as a corrosion inhibitor also significantly improve lubricity but can incur conductivity problems in the field due to its synergistic effects with antistatic additive. The feasibility of a fuel lubricity test by chemical, physical or mechanical techniques are being studied. Author

N72-11680# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**FLAME INHIBITION CHEMISTRY** c33
R. M. Fristrom and R. F. Sawyer *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety refs (See N72-11668 02-27)
(Grant NSF GI-12)
Avail: NTIS HC $6.00/MF $0.95

Techniques involving diverse mechanisms are employed in extinguishing flames and fires. Mechanisms were divided into two broad categories: (1) physical mechanisms when mechanical or thermal effects are dominant, and (2) chemical mechanisms when chemical effects are involved. Flame extinguishment viewed from the standpoint of the effects on the elementary reaction processes is reviewed. A simplified hydrogen-oxygen flame chemistry is used as an illustration. The complications introduced by chemical inhibition are pointed out. The chemical kinetic information in the area of hydrogen atom scavenging and oxygen flame radical recombination is surveyed. Author

N72-11681# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.

**FLAMMABILITY PROPERTIES OF JET FUELS AND TECHNIQUES FOR FIRE AND EXPLOSION SUPPRESSION** c33

B. P. Botteri *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

Results of investigative efforts to establish the practical flammability envelopes and associated combustion damage potential for conventional jet fuels such as JP-4, JP-8 (similar to JET A-1), and JP-5 under simulated hostile operating environment conditions are presented. Testing included liquid-space gunfire hits to assess external fire hazard and vertical (liquid to vapor) firing trajectories to determine explosion hazard associated with projectile-induced fuel sprays and mists. All tests were performed in instrumented replica target tanks varying in volume from 15 to 90 gallons. Principal test variables were fuel temperature, pressure, fuel depth, external void space, and internal and external air flow. All tests were conducted utilizing 0.50-caliber armor piercing incendiary projectiles. These tests indicate a considerable extension in the flammability range of all fuels compared to the equilibrium flammability limit values which are commonly utilized for fire safety analysis. In view of the fire and explosion potential exhibited by all conventional jet fuels, additional measures must be employed to achieve an effective fire-protection capability. Progress in the use of reticulated polyurethane foam, halogenated hydrocarbon chemical extinguishants, and other fuel-tankinerting techniques is also reviewed. Author

N72-11682# Institut Francais du Petrole, Paris (France).

**INFLUENCE OF MOLECULAR STRUCTURE ON SELF-IGNITION PROPERTIES OF HYDROCARBONS [INFLUENCE DE LA STRUCTURE MOLECULAIRE SUR CERTAINES PROPRIETES D'AUTO-INFLAMMATION DES HYDROCARBURES]** c33

G. DeSoete *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

The adiabatic compression method was used to determine delays in self-ignition by different hydrocarbon-air mixtures as a function of pressure and temperature. A comparison of experimental results makes it possible to evaluate the effect of some special molecular structure characteristics on the overall activation energy. In particular, the presence of ternary carbon atoms and double carbon-carbon bonds results in a decrease in this activation energy. Tests made with mixtures of two different hydrocarbons show that the kinetic parameters controlling the dependency of ignition delay on temperature vary in such a way that the delay with a mixture tends to approach that of the pure component having the shortest delay at the temperature considered. This phenomenon was found to be all the greater as the relative concentration of this component in the binary mixture is higher. Author

N72-11683# Princeton Univ., N.J. Guggenheim Lab.

**IGNITION OF FUELS BY A HOT PROJECTILE** c33

O. P. Sharma and W. A. Sirignano *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 16 p refs (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

Theoretical investigations were performed by approximating: (1) the flow at the forward end of the projectile to a stagnation flow towards a hot axisymmetric body, (2) the flow over its surface to a laminar flow over a hot plate, and (3) the flow in the wake of the projectile to a plane laminar mixing of the cold unreacted mixture with the hot combustion products. After the premixed mixture is exhausted, there is a possibility of ignition of unmixed reactants by the hot inert products which are left behind and are sandwiched between the oxidizer and the fuel. A theoretical analysis for the ignition delay time as a function of the temperature and the width of the hot gas region is also presented. Author

N72-11684# Centre National de la Recherche Scientifique, Paris (France).

**INFLUENCE OF PROMOTERS (FREE RADICALS) AND INHIBITORS ON DIFFUSION FLAMES [INFLUENCE DES PROMOTEURS (RADICAUX LIBRES) ET DES INHIBITEURS SUR LES FLAMMES DE DIFFUSION]** c33

J. Combourieu, C. Falinower, and G. Denis *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

The laminar diffusion flames of acetylene with molecular oxygen and with molecular oxygen partly dissociated were stabilized in a low pressure vessel. A partial dissociation of O2 into O atoms was produced by a powerful microwave discharge. Concentration profiles of stable species were determined with a microprobe and a mass spectrometer. Temperature profiles were obtained from a silica-coated thermocouple. The intensities of spectral emission were recorded for excited species with a spectrophotometer. The complex structure of these diffusion flames shows that the combustion of C2H2 involves several steps. The partial dissociation of O2 emphasizes the significant role played by O atoms in the combustion of C2H2. The influence of halogenated inhibitors is very different according to the kind of inhibitor and whether it is added to the oxidizer or the fuel. Author

N72-11685# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.

**CONTRIBUTION TO THE SELECTION OF FIRE EXTINGUISHING SYSTEMS AND AGENTS FOR AIRCRAFT FIRES** c11

R. Fiala *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 10 p refs (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

A fire extinguishing-system in aircraft is described, which uses the exhaust gases of a solid-propellant gas generator to pressurize the extinguisher bottle. The extinguishing efficiency of this hot-bottle-system is compared with that of the current extinguishing system. The amount of agent which is necessary to extinguish a diffusion flame was measured for a number of halons, dry powders, and mixtures of dry powders and halons. The ability of agents to prevent reignition of the extinguished fuel surface by hot parts was also tested. Author

N72-11686# Shell Research, Ltd., Chester (England).

**ELECTROSTATIC CHARGING IN THE HANDLING OF AVIATION FUELS** c33

H. Strawson and A. Lewis *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)

Avail: NTIS HC $6.00/MF $0.95

Electrostatic charging of the fuel during fueling can result in the possibility of incendiary sparking in aircraft tanks; some of the more recent experimental results on the different phases of this process are presented. These results confirm that, in the absence of special precautions, discharges creating a tank explosion hazard can exist during aircraft refueling in certain circumstances. Unless the fuel conductivity is controlled, however, these hazardous circumstances cannot be precisely predicted. The use of a static dissipator additive eliminates the hazard. Methods of introducing the additive and of maintaining the correct conductivity during fuel distribution are discussed, as well as possible side effects and interactions with other fuel additives. On the basis of world-wide airline use over many years, supported by many laboratory tests, it is concluded that the additive provides a safe, simple and trouble-free solution to the problem. Author

N72-11687# National Aviation Facilities Experimental Center, Atlantic City, N.J.

**CRASH SAFE TURBINE FUEL DEVELOPMENT BY THE**

**FEDERAL AVIATION ADMINISTRATION, 1964 - 1970**
R. A. Russel, Jr. *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 10 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Crash-safe fuel program, a segment of a primary mission to improve the overall crashworthiness of aircraft, is discussed. The reduction of the probability and severity of fire during aircraft ground crash situations is also examined. Author

N72-11688# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
**EMULSIFIED FUELS AND AIRCRAFT SAFETY**
W. D. Weatherford, Jr. and F. W. Schaekel (Army Coating and Chem. Lab.) *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs (See N72-11668 02-27)
(Contracts DAAD05-70-C-0250; DAAJ02-69-C-0030)
Avail: NTIS HC $6.00/MF $0.95

Research and development program aimed at improving the post-crash fire safety of helicopter turbine-engine fuels is reviewed. Primary emphasis was placed on high-internal-phase-ratio aqueous emulsions. Interrelations among rheological and physical properties, composition, and fire safety characteristics of various fuel formulations are discussed. Implications of these results on the total safety envelope of rotary wing aircraft are examined. Author

N72-11689# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.
**FIRE HAZARD EVALUATION OF THICKENED AIRCRAFT FUELS**
J. M. Kuchta, J. N. Murphy, A. L. Furno, and A. Bartkowiak *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Various gelled or emulsified fuels were proposed for reducing the aircraft crash-fire hazard. Results are presented from bench-scale tests for screening the fuels and from large-scale drop tests for evaluating their fire hazard under simulated crash conditions. Jet A and Jet B type thickened fuels were investigated. Their minimum autoignition temperatures and burning rates varied little, whereas their flash points, volatility rates, self-spread rates, and flame spread rates varied noticeably with either the base fuel or thickening agent composition; minimum ignition energies are also compared for liquid sprays. The performance of the thickened fuels, particularly Jet B emulsions, was not very promising under impact conditions. In fuel drops made from a 150-ft three-tower facility, the fireball size and radiation intensity varied with impact velocity, impact angle, and type of fuel container. Author

N72-11690# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
**FIRE AND EXPLOSION PROTECTION OF FUEL TANK ULLAGE** c33
J. A. MacDonald and H. W. G. Wyeth *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 7 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The conditions that can lead to an explosion within aircraft fuel tank ullages are examined, and the need for protection systems is reviewed. Principles employed in providing the desired degree of protection are outlined, such as oxygen reduction, vapor or mist inerting, and plastic foam fillers. Comparisons were made between the various sytems, and their relative merits were also discussed. It is concluded that plastic foam is an effective system provided that the material is compatible with the environment. Liquid nitrogen is also attractive from the weight aspect but could impose logistic problems. Author

N72-11691# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.
**INVESTIGATION OF FIRE EXTINGUISHING POWDERS BY MEANS OF A NEW MEASURING PROCEDURE** c18
R. Fiala and G. Winterfeld *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

In order to optimise fire extinguishing systems it is necessary to compare the extinguishing efficiency of solid and gaseous (or liquid) extinguishing agents. A measuring procedure is described which allows this direct comparison. It makes use of the relationship between the maximum flow velocity at the burning limit of a flame-holder stabilized flame and the laminar burning velocity of the fuel-air-mixture which is given by DAMKOHLER's first number. Comparative results achieved with this procedure for several fire extinguishing agents are given. Author

N72-11692# Royal Aircraft Establishment, Farnborough (England). Materials Dept.
**SIMULATED CRASH TESTS AS A MEANS OF RATING AIRCRAFT SAFETY FUELS** c33
R. E. Miller and S. P. Wilford *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Two tests are described for assessing the fire resistance of Avtur containing polymeric additives which reduce its ability to form flammable mists. In the standard test a tank containing ten or twenty gallons of fuel is propelled on a rocket sled at speeds of 114 or 188 ft/sec and decelerated after contact with an aircraft arrester wire. Fuel is allowed to spill from a slit in the tank onto a series of ignition sources. In the run on test the tank travels at speeds up to 240 ft/sec past a series of ignition sources while spilling fuel from a slit on the leading edge. The velocities of spilled fuel relative to the surrounding air which occur in these tests are shown to be comparable to those occurring during survivable aircraft crashes. Author

N72-11693# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**SURFACE ACTIVE CONSIDERATIONS IN FUEL FIRES** c33
Richard L. Tuve *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 4 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The problem of efficient extinguishment of fires in burning fuels is dealt with. The use of low density water, in the form of foam, is considered as a means of achieving some solutions to the mechanical and physical needs involved. Emphasis is placed on the utilization of fluorocarbon surfactants which combine foam requirements and fuel-water interfacial activities benefitting fire extinguishing action. Recent development and test of these materials are discussed. D.L.G.

N72-11694*# General Electric Co., Cincinnati, Ohio. Material and Process Technology Labs.
**LUBRICANT AND FUEL INTERACTIONS IN ADVANCED AIRCRAFT GAS TURBINES** c15
E. N. Bamberger, D. B. Hester, and M. W. Shayeson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs Sponsored in part by NASA, AFAPL, and FAA (See N72-11668 02-27)
(NASA-CR-122842) Avail: NTIS CSCL 11H

The interactions and relationships between lubricants and fuels and their properties as related to systems in aircraft gas turbine engines are dealt with. Three areas of recent research are cited to illustrate the impact of lubricant and fuels capabilities on modern engines: (1) a study of the influence of lubricant properties on turbine engine design characteristics, especially with regard to high speed supersonic applications, (2) the development of a precise and meaningful test procedure for measuring the thermal stability of kerosene fuels, and (3) the evaluation of advanced high temperature lubricating fluids and their effects on engine bearing performance. Author

N72-11695# Esso Development Co., Ltd., Abingdon (England). Research Centre.
**STABILITY OF SYNTHETIC AVIATION GAS TURBINE LUBRICANTS AT HIGH TEMPERATURES** c15
R. Robson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

The development of ester based synthetic aviation lubricants over the last 20 years is reviewed. Methods of assessing the high temperature stability of the lubricants are described and the main factors controlling stability are discussed. The suitability of alternative synthetic fluids is considered. Author

N72-11696# Institut Francais de Petrole, Grenoble (France).
**SYNTHESIS AND PROPERTIES OF ESTERS OF TETRA-METHYL-2,2-7,7 OCTANE DIOL-1,8 [LES ESTERS DU TETRA METHYL-2,2-7,7 OCTANE DIOL-1,8 SYNTHESE ET PROPRIETES]** c06
P. Bedague, B. Sillion, and G. DeGaudemaris *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs In FRENCH (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

A diol of the neopentylic type was obtained by a series of simple reactions proceeding from cyano-4 dimethyl-2,2 butyraldehyde. Esters of linear acids and alpha alpha prime dimethylated acids were synthesized. Their physical characteristics were determined. Thermal stability and resistance to hydrolysis and oxidation in the presence of metals were examined.
Transl. by K.P.D.

N72-11697# Rolls-Royce, Ltd., Bristol (England). Engine Div.
**LUBRICANT EXPERIENCE AND DUTIES IN A CIVIL SUPERSONIC GAS TURBINE ENGINE** c15
E. W. Doherty *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p ref (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

A description is presented of the Olympus 593 Mk 602 oil system generally, and particular reference is given to the design precautions against the oil fire risk, the use of oil in engine failure warning devices, and in engine health monitoring. Current engine test and flight experience with the lubricant is covered especially with respect to oil consumption, high temperature breakdown areas, prevention of oil carbon formation, mixing of lubricants brands, erosion/corrosion effects, and policy in approval processes of lubricants. Author

N72-11698# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.
**EARLY STAGE DETECTION OF OIL CHANGES IN AIRCRAFT ENGINES** c15
E. Jantzen *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Potential analytical methods for detection of changes in aircraft turbine oils in the early state are reported and their possible advantages and disadvantages as well as their informative value are discussed. In addition, the cause of prematured or sudden oil changes in an aircraft engine is investigated. A test rig for simulating such oil changes and the results obtained are discussed. In conclusion, the possibilities of a simultaneous wear control of aircraft turbine oils are briefly explained. Author

N72-11699# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**THERMAL STABILITY OF A TRI-METHYL-PROPANE ESTER BASED LUBRICATING OIL [CHAMP D'APPLICATIONS D'UNE HUILE BASEE SUR UN ESTER DU TRIMETHYLOL-PROPANE]** c15
F. Reynaud *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 22 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Following a general discussion on the increased performance requirements of lubricating oils made mandatory by increased operating temperatures, the operational possibilities of a tri-methyl-propane ester in two domains of application are described. The first area of application considered was a conventional circuit with oil temperature around 230 C. By adding appropriate additives, a formula was developed with very satisfactory characteristics, particularly in regard to oxidation corrosion. The second area of usage studied was at the 380 C level. The formula appeared not to be well adapted to the new conditions, with some additions losing their efficiency. However the ester remained valid as a base. D.L.G.

N72-11700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
**SOLID LUBRICATION FOR AERO PROPULSION SYSTEMS** c15
M. R. Chasman *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Self contained solid lubricated bearings were developed for application to current and future aircraft propulsion and power generation equipment. The capability for long life operation over a wide range of temperatures in an air environment was demonstrated. The approach was to use solid lubricants as a sacrificial retainer material in 20 mm and 35 mm bore bearings. In some cases stainless steel and titanium shrouds were used to provide added strength to the solid lubricant retainers. Lubricants were selected based on their strength, oxidation, friction, and wear properties. It was necessary to deviate from oil and grease lubricated bearing design to achieve acceptable life. Bearing clearance, number of balls, retainer to land clearance, and ball pocket size were optimized. Hundreds, and in some cases thousands, of hours of life were demonstrated. Author

N72-11701# BP Benzin und Petroleum AG, Munich (West Germany).
**SYNTHETIC LUBRICANTS FOR SUPERSONIC AIRCRAFT** c15
H.-D. Dorn *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 6 p (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

Classifications and characteristics of synthetic aero turbine oils are reviewed. These oils are classified as type 1 and type 2 lubricants. The type 1 lubricants are defined as blends of a diester basestock and an additive package. Although still being used in jet engines, their use in advanced turbines is considered to be limited by marginal resistance to thermal and oxidative stress. Type 2 lubricants, developed to meet the increased requirements of more sophisticated aircraft, are defined as blends of a hindered tri- or tetraester basestock and an additive package. The burden placed on these lubricants by sustained flight at supersonic speeds is discussed, and the development of an advance complex ester lubricant with a novel additive package for Mach 2 + engines is reported. D.L.G.

N72-11702*# Rocket Research Corp., Redmond, Wash. York Center.
**PLANETARY EXPLORER LIQUID PROPULSION STUDY**
**Final Report, Jul. 1970 - Mar. 1971**
F. X. McKevitt, R. F. Eggers, and C. W. Bolz Jun. 1971 301 p refs
(Contract NAS5-11296)
(NASA-CR-123369; RRC-71-R-249) Avail: NTIS HC $6.00/MF $0.95 CSCL 21H

An analytical evaluation of several candidate monopropellant hydrazine propulsion system approaches is conducted in order to define the most suitable configuration for the combined velocity and attitude control system for the Planetary Explorer spacecraft. Both orbiter and probe-type missions to the planet Venus are considered. The spacecraft concept is that of a Delta launched

spin-stabilized vehicle. Velocity control is obtained through preprogrammed pulse-mode firing of the thrusters in synchronism with the spacecraft spin rate. Configuration selection is found to be strongly influenced by the possible error torques induced by uncertainties in thruster operation and installation. The propulsion systems defined are based on maximum use of existing, qualified components. Ground support equipment requirements are defined and system development testing outlined. Author

N72-11703# Oak Ridge National Lab., Tenn.
**SOME PROPERTIES OF LITHIUM HYDRIDE WITH RESPECT TO ITS USE AS A ROCKET FUEL. PART 1: THE DENSITY OF LiH GRAINS FORMED BY COMPRESSION OF LiH POWDER**
R. E. Lo Jun. 1971 17 p refs
(ORNL-TR-2471; DLR-FB-65-49) Avail: NTIS

The production of LiH fuel grains for combustion in hydride rocket motors is described. An empirical formula is derived for calculating the density which is to be expected at various pressures of formation for LiH fuel grains of given mass and cross section. Author

N72-11704# Oak Ridge National Lab., Tenn. Office of Language Services.
**SOME PROPERTIES OF LITHIUM HYDRIDE WITH RESPECT TO ITS USE AS A ROCKET FUEL. PART 3: SPONTANEOUS INSTABILITY OF COMMERCIAL LITHIUM HYDRIDE**
R. E. Lo Jul. 1970 27 p Transl. into ENGLISH of German report DLR-FB-70-26
(ORNL-TR-2473-Pt-3) Avail: NTIS

Due to the reaction of LiH + LiOH. H2O yields 2 LiOH + H2 commericial grade lithium hydride gives off gaseous hydrogen. The dependence on hydrate concentration and temperature of this reaction has been studied. A formula for the calculation of the hydrogen quantity as a function of storage time is presented, since knowledge of this quantity is important - among other factors - for hybrid rocket engines using LiH-base fuels. Further, the velocity of the reaction between LiH-powder and LiH-grains and moisture has been determined its dependence upon grain density and air humidity is presented. Author

N72-11705# Martin Marietta Corp., Denver, Colo.
**SOLID-STATE BONDED LIQUID ROCKET PROPELLANT CONTAINERS Final Technical Report, 18 Dec. 1968 - Jul. 1971**
Charles L. Caudill and Roland L. Kirlin Edwards AFB, Calif. AFRPL Jul. 1971 158 p
(Contract F04611-69-C-0056; AF-Proj.3058)
(AD-725776; MCR-71-124; AFRPL-TR-71-69) Avail: NTIS CSCL 13/4

The report covers the design, development, fabrication, test, and evaluation of liquid rocket propellant containers fabricated by solid-state bonded methods. There were no fusion welded joints. The objective of this program was to develop liquid propellant tankage with a zero-leak potential and joints with parent material strength. The program was conducted in four phases: (1) Preliminary design and analysis; (2) Bonding development; (3) Prototype tankage fabrication and test; and (4) Fabrication of tankage for propellant storability tests. The original program was initiated in February 1969. All tanks produced up to this point were made from A-286 alloy. Author (GRA)

N72-11706# Phillips Petroleum Co., Bartlesville, Okla. Research and Development Dept.
**EFFECT OF VERY LOW SULFUR IN JP-5 FUEL ON HOT CORROSION**
Robert M. Schirmer and Harold T. Quigg 20 May 1971 33 p refs Presented at the 10th Natl. Conf. on Environ. Effects on Aircraft and Propulsion Systems, Trenton, 18-20 May 1971; Sponsored by Naval Air Propulsion Test Center
(AD-725619) Avail: NTIS CSCL 20/4

The report discusses an investigation to determine whether the present limit of 0.4 percent by weight (4000 ppm) of sulfur in JP-5 fuel is a safe level for the protection of turbine-blade materials from hot corrosion in high-performance engines when operated in a marine environment. The present study shows that a 100-fold reduction in the sulfur limit to 40 ppm would not reduce hot corrosion significantly. Such reductions in the sulfur limit would drastically curtail fuel availability, since they approach the mean and the minimum of current production, and could cause critical problems in logistics. It was found that the use of an essentially sulfur-free fuel, containing only 4 ppm sulfur, significantly decreased both the surface scale on specimens and the weight lost by specimens of a wide variety of superalloys and superalloy-coating systems when exposed under conditions which simulate those in an aircraft-turbine engine ingesting air with 1 ppm sea salt. Thus, indications are that the sulfur in fuel must be below a 'threshold' concentration to improve the durability of turbine-blade materials. Author (GRA)

# 28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N72-11707 National Lending Library for Science and Technology, Boston Spa (England).
**THE EFFECT OF THE AXIAL CLEARANCE UPON THE FATIGUE STRENGTH OF THE ROTOR BLADES IN AXIAL TURBINES [VLIYANIE OSEVOGO ZAZORA NA DINAMICHESKUYU PROCHNOST RABOCHIKH LOPATOK OSEVYKH TURBIN]**
A. A. Moiseev, Yu. I. Mityushkin, S. A. Alekseev, and V. I. Filatov Oct. 1971 12 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 3, 1971 p 12-15
(NLL-RTS-6658) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.20 or 4 NLL photocopy coupons

The experimental investigations carried out on the effect of the axial clearance on the periodic bending stresses in roto. blades due to aerodynamic forces under resonant oscillation conditions, lead to the following conclusions: With a radial arrangement of nozzle blade trailing edges and at moderate radial clearances between the nozzle and rotor cascades, the increase in the harmonic order of the oscillations leads to a reduction in the periodic bending stresses of rotor blades in the plane of rotation of the rotor cylinder cascade. When the nozzle blades are inclined with their concave sides towards the turbine axis, the periodic stresses do not depend upon the harmonic order of the oscillations. Author

N72-11708* Brown Engineering Co., Inc., Huntsville, Ala.
**INFLATABLE TRANSPIRATION COOLED NOZZLE Patent**
Donald E. Pryor, Benjamin K. Holmes, James R. Thompson, Jr., Charles N. Scott, and William W. Sowa, inventors (to NASA) Issued 3 Aug. 1971 5 p Filed 12 Mar. 1970 Sponsored by NASA Supersedes N70-26809 (08 - 13, p 2470)
(NASA-Case-MFS-20619; US-Patent-3,596,465; US-Patent-Appl-SN-18982; US-Patent-Class-60-271; US-Patent-Class-139-425R; US-Patent-Class-239-265-19; US-Patent-Class-239-265-43) Avail: US Patent Office CSCL 21H

A rocket engine nozzle skirt is considered for increasing the expansion ratio of a main engine nozzle. The skirt is fabricated from a woven, double wall, fabric material which can be folded back around the main nozzle and later inflated to achieve its desired shape. The exterior surface of the nozzle extension is coated with a porosity such that the inflation gas bleeds through to provide transpiration cooling of the nozzle skirt.
Official Gazette of the U.S. Patent Office

N72-11709* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**FEED SYSTEM FOR AN ION THRUSTER Patent**
Tommy D. Masek, inventor (to NASA) Issued 13 Jul. 1971 6 p Filed 5 Sep. 1968 Sponsored by NASA
(NASA-Case-NPO-10737; US-Patent-3,591,967; US-Patent-Appl-SN-760114; US-Patent-Class-60-202; US-Patent-Class-60-39-48) Avail: US Patent Office CSCL 21C

A system for delivering vaporized mercury to an electron bombardment ion engine characterized by a source of liquid mercury, pressurized by Freon vapor for force-feeding liquid mercury to a mercury vaporized at a temperature and a pressure sufficient to deliver vaporized mercury at a constant, low-rate flow to an associated ion engine. Author

N72-11710*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**APPLICATION OF HYBRID PROPULSION SYSTEMS TO PLANETARY MISSIONS**
John P. Don and Robert L. Phen 1 Nov. 1971 38 p refs
(Contract NAS7-100)
(NASA-CR-123356; JPL-TM-33-483) Avail: NTIS CSCL 21H

The feasibility and application of hybrid rocket propulsion to outer-planet orbiter missions is assessed in this study and guidelines regarding future development are provided. A Jupiter Orbiter Mission was selected for evaluation because it is the earliest planetary mission which may require advanced chemical propulsion. Mission and spacecraft characteristics which affect the selection and design of propulsion subsystems are presented. Alternative propulsion subsystems, including space-storable bipropellant liquids, a solid/monopropellant vernier, and a hybrid, are compared on the basis of performance, reliability, and cost. Cost-effectiveness comparisons are made for a range of assumptions including variation in (1) the level of need for spacecraft performance (determined in part by launch vehicle injected mass capability), and (2) achievable reliability at corresponding costs. The results indicated that the hybrid and space-storable bipropellant mechanizations are competitive. Author

N72-11711*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**FLIGHT INVESTIGATION OF AIRFRAME INSTALLATION EFFECTS ON AN AUXILIARY INLET EJECTOR NOZZLE ON AN UNDERWING ENGINE NACELLE**
Richard R. Burley Washington Nov. 1971 71 p refs
(NASA-TM-X-2396; E-6208) Avail: NTIS CSCL 21E

The local flow field approaching an installed nozzle may vary from isolated test conditions, thereby affecting exhausting nozzle performance. An installation of general interest is a podded engine mounted near the aft lower surface of the wing. The effect of this installation on the performance of an auxiliary inlet ejector nozzle was investigated over a Mach number range of 0.7 to 1.3 by using a modified F-106B aircraft. Both floating and fixed-open door configurations were examined. The ejector nozzle trailing-edge flaps were simulated in the closed position with rigid structure which provided a boattail angle of 15 deg. Primary nozzle area was varied as exhaust gas temperature was varied between 982.2 and 2003.3 K. Author

N72-11712# Aerospace Corp., El Segundo, Calif.
**HYBRID HEAT ENGINE/ELECTRIC SYSTEMS STUDY. VOLUME 2: APPENDICES A THROUGH F**
Joseph Meltzer and Donald Lapedes 1 Jun. 1971 313 p
(Contract F04701-70-C-0059)
(PB-201646; TOR-0059(6769-01)-2-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 13F

The report contains supplementary data forming the appendices for Volume 1 of the Final Report with the same title. Author (GRA)

N72-11713# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
**INVESTIGATION OF FEASIBILITY OF INTEGRAL GAS TURBINE ENGINE SOLID PARTICLE INLET SEPARATORS. PHASE 2: FEASIBILITY DEMONSTRATION Final Report**
William J. McAnally, III and Max T. Schilling Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Apr. 1971 65 p refs
(Contract DAAJ02-70-C-0003; DA Proj. 1-G-162207-AA-71)
(AD-725593; PWA-FR-4197; USAAVLABS-TR-71-13) Avail: NTIS CSCL 21/5

Two different sand and dust particle separator test rigs were fabricated and tested to evaluate separation efficiency, aerodynamic performance characteristics, and operation in rain and foliage ingestion conditions. The semi-reverse-flow separator utilized fixed turning vanes on a contoured hub to induce swirl in an annular duct. At design airflow of 8 lb/sec and 40% scavenge flow, the semi-reverse-flow separator demonstrated 88.5% separation efficiency with AC coarse test dust at an average pressure drop of 2.8 in. H2O. The powered mixed-flow separator attempted to utilize the strong centrifugal field available in a mixed-flow impeller turning at the high speeds characteristic of small gas turbine engines to achieve particle separation. At the design airflow of 8 lb/sec, it demonstrated a maximum separation efficiency of 58.7% with 8.4% scavenge flow and an average pressure rise of 6.76 psi. Both separator concepts were determined to be feasible and the semi-reverse-flow separator is considered to be superior to current engine air particle separators for the majority of aspects investigated. Author (GRA)

N72-11714# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**A STUDY OF NOISE GENERATION BY A ROTATING BLADE ROW IN AN INFINITE ANNULUS Interim Scientific Report, 7 Jul. 1969 - 31 Mar. 1971**
John A. Lordi May 1971 73 p refs
(Contract F44620-69-C-0130; AF Proj. 9781)
(AD-726126; CAL-AI-2836-A-1; AFOSR-TR-71-1485) Avail: NTIS CSCL 13/1

Discrete-tone noise generation by high-speed fans and compressors has been studied by applying existing theories for the flow through a rotating blade row in an infinitely long annulus. McCune's analysis for the linearized, three-dimensional, compressible flow through a nonlifting blade row and its recent extension to lifting blades have both been used to find the acoustic disturbances produced by such flows. These analyses contain the cutoff condition for the duct acoustic modes, including the effect of through flow, and relate the amplitudes of the propagating modes to the blade thickness and loading. In the present work these relationships have been evaluated for some specific thickness and loading distributions to find the pressure and velocity fields away from the blade row. Methods have been developed to calculate the sound intensity flux upstream and downstream of the blade row and results are presented which demonstrate the influence of blade geometry and operating conditions on noise generation. Author (GRA)

N72-11024# Wall Colmonoy Corp., Detroit, Mich.
**REMANUFACTURING OF JET ENGINE COMPONENTS EMPLOYING BRAZING TECHNIQUES**
Robert Leon Peaslee *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 10 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

N72-11030# Pratt and Whitney Aircraft, East Hartford, Conn.
**MODULAR DESIGN CONCEPT IMPROVES JET ENGINE MAINTAINABILITY**
George P. Adamson *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 32 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

# 29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N72-11715 National Lending Library for Science and Technology, Boston Spa (England).
**THE MAGNETIC FIELD AND ELECTRIC CURRENTS OF THE UNIPOLAR SUNSPOT [MAGNITNOE POLE I ELEKTRICHESKIE TOKI UNIPOLYARNOGO SOLNECHNOGO PYATNA]**
V. A. Kotov Aug. 1971 34 p refs Transl. into ENGLISH from Izv. Krym. Astrofiz. Observ. (USSR), v. 41-42, 1970 p 67-88
(NLL-RTS-6586) Avail: Natl. Lending Library, Boston Spa, Engl.: £3.40; 11 NLL photocopy coupons

Photoelectric recordings of the total field vector H in a large unipolar sunspot were made simultaneously in the 4808 Fe(I) and 6102.7 Ca(I) lines, and the H parallel field was obtained in H alpha line. The chromospheric longitudinal field H parallel is comparable with the photospheric value. The magnetic vector H is vertical at both photospheric levels in a very small region. The presence of a strong H perpendicular field within the spot and the large change in the H perpendicular vector orientation with depth are noted. An appreciable azimuth component at both levels shows a clockwise twist of the field. A gradient analysis shows that a transparent spot model best fits the observations. The vertical electric current density is 1000 to 10,000 CGSE, and its mean value at the lower level 4808 A is twice that at the upper one 6102.7 A. The total currents directed upwards and downwards compensate each other at both levels. The transverse current (10,000 CGSE) flows mainly perpendicular to the vector H perpendicular. Author

N72-11716*# American Nucleonics Corp., Woodland Hills, Calif.
**A STUDY OF THE ELECTROMAGNETIC INTERACTION BETWEEN PLANETARY BODIES AND THE SOLAR WIND**
Interim Final Report
K. Schwartz Mar. 1971 90 p refs
(Contract NAS2-5876)
(NASA-CR-114376) Avail: NTIS CSCL 03B

Theoretical and computational techniques were developed for calculating the time dependent electromagnetic response of a radially inhomogeneous moon. The techniques were used to analyze the experimental data from the LSM (lunar surface magnetometer) thus providing an in-depth diagnostic of the Lunar interior. The theory was also incorporated into an existing computer code designed to calculate the thermal evolution of planetary bodies. The program will provide a tool for examining the effect of heating from the TE mode (poloidal magnetic field) as well as the TM mode (toroidal magnetic field). Author

N72-11717*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MATHEMATICAL MODEL OF THE SOLAR RADIATION FORCE AND TORQUES ACTING ON THE COMPONENTS OF A SPACECRAFT**
R. M. Georgevic 1 Oct. 1971 111 p refs
(Contract NAS7-100)
(NASA-CR-123361; JPL-TM-33-494) Avail: NTIS CSCL 03B

General expressions for the solar radiation force and torques are derived in the vectorial form for any given reflecting surface, provided that the reflecting characteristics of the surface, as well as the value of the solar constant, are known. An appropriate choice of a spacecraft-fixed frame of reference leads to relatively simple expressions for the solar radiation forces and torques in terms of the functions of the sun-spacecraft-earth angle. Author

N72-11718*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE TWELFTH INTERNATIONAL CONFERENCE ON COSMIC RAYS**
Nov. 1971 84 p refs Conf. held at Hobart, Tasmania, 1971
(NASA-TM-X-65753; X-661-71-461) Avail: NTIS CSCL 04A

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2. CHARGE COMPOSITION OF GALACTIC COSMIC RADIATION J. F. Ormes, V. K. Balasubrahmanyan, and M. J. Ryan p 9-18 refs (See N72-11720 02-29)
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N72-11719*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE COSMIC RAY PROTON AND HELIUM SPECTRA ABOVE 50 GeV**
M. J. Ryan, V. K. Balasubramanyan, and J. F. Ormes *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 1-8 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

The primary cosmic ray proton and He spectra from 50 GeV to 2000 GeV have been measured by an ionization spectrometer flown on a balloon. At low energies, the energies of individual events are determined to within + or - 30%. At higher energies, the cascade is not fully contained within the four mean free path thick spectrometer and the problems of estimating the energies of these events are discussed. The proton spectrum continued with constant exponent = -2.7 + or - 0.1 up to energies greater than 1000 GeV. This spectrum was in agreement with the results at the low energies. There was no evidence for a spectral break at about 1000 GeV observed. Author

N72-11720*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**CHARGE COMPOSITION OF GALACTIC COSMIC RADIATION**
J. F. Ormes, V. K. Balasubrahmanyan, and M. J. Ryan *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 9-18 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

Experimental results from the balloon borne ionization spectrometer have enabled the extension of the measurement of the energy spectra of cosmic rays to 10 to the 12th power eV. The exposure factor for this flight was 1825 sq m/sr/sec and approximately 10,000 nuclei with Z greater than or equal to 3 have been observed. Differential spectra of individual nuclei from lithuum to oxygen and from groups of nuclei with Z = 10-14, 15-19, 20-23, and 24-30 energy range 2 x 10 to the 10th eV to 10 to the 12th eV are described in a power law representation. Results indicate that the composition of galactic cosmic rays remains similar to that observed at lower energies. These results from direct measurements provide evidence for the processes of source acceleration with interstellar propagation remaining essentially energy independent up to 10 to the 12th power eV. Author

N72-11721*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ENERGY DEPENDENCE OF CROSS SECTIONS OF COSMIC RAY NUCLEI IN TUNGSTEN**
V. K. Balasubrahmanyan, C. J. Crannell (Federal City Coll.), F. A. Hagen (Md. Univ.), J. F. Ormes, and M. Ryan *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 19-25 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

An ionization spectrometer consisting of 12 layers of tungsten each 6.13 gm cm/2 thick and 7 iron modules each 70 gm cm/2 thick was flown in a balloon at an altitude of 6 gm cm/2 for 16 hours. The distributions of the first interaction points are used to determine the mean free path of the incident particles. At energies of 20 GeV the proton m.f.p. of 140 gm cm/2 is in agreement with that of other workers. The m.f.p.'s of heavy nuclei have been determined as a function of energy up to a total energy of 1000 GeV. These results are compared with the overlap model of nucleus-nucleus collisions. For C nuclei interacting with W the overlap parameter is -2.6 x 10/13 cm. The energy dependence of this parameter is discussed. Author

N72-11722*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE PRIMARY COSMIC RAY ELECTRON SPECTRUM FROM 10 GeV TO ABOUT 200 GeV**
R. F. Silverberg (Md. Univ.), J. F. Ormes, V. F. Balasubrahmanyan, and M. J. Ryan *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 27-32 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

An ionization spectrometer consisting of 10.8 radiation lengths of tungsten and 35 radiation lengths of iron has been used to determine the energy spectrum of cosmic ray electrons above 10 GeV. The spectrometer was calibrated with electrons from 5.4 to 18 GeV and then flown at an altitude of 6 gm-cm/2 for 16 hours. Separation of electron initiated events from proton events was achieved by utilizing starting point distributions, the shower development in tungsten, and the energy deposited in the large thickness of iron absorber. The exponent of the differential energy spectrum of the electrons is -3.1 + or - 0.2 while the exponent of the background is consistent with the proton exponent of -2.7 + or -0.2. Author

N72-11723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ACCELERATION AND PROPAGATION OF HIGH Z COSMIC RAYS IN A PULSAR ENVIRONMENT**
V. K. Balasubrahmanyan, J. F. Ormes, and M. J. Ryan *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 33-41 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

The survival of high Z nuclei in the X-ray photon field of a pulsar is investigated. For heavy nuclei with energies greater than or equal to 100 GeV/nucleon, 100 keV X-ray photons have sufficient energy to cause photodisintegration with cross sections of approximately 10 to the minus 25th power sq cm. Using the observed properties of the Crab pulsar, extrapolation back to epochs when the pulsar was more active indicates that the photon field is sufficiently dense to prevent the acceleration of heavy nuclei within the velocity of light cylinder. On this model, the upper limit on the energy of the escaping nuclei varies with time. The models for cosmic ray acceleration in supernova explosions or by pulsars will be related to experimental observations. Author

N72-11724*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GAMMA RAY EXPERIMENT FOR THE SMALL ASTRONOMY SATELLITE B (SAS-B)**
C. E. Fichtel, C. H. Ehrmann, R. C. Hartman, D. A. Kniffen, H. B. Ogelman, and R. W. Ross *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 42-46 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

A magnetic core digitized spark chamber gamma ray telescope has been developed for satellite use. The detector has the following characteristics: effective area = 500 cu/cm, solid angle = 1/4 SR; efficiency (high energy) = 0.29; and time resolution of better than two milliseconds. Author

N72-11725*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SHORT TIME-SCALE OPTICAL PULSATIONS IN THE NIGHT SKY BACKGROUND** c13
D. L. Bertsch, A. Fisher, and H. Ogelman *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 47-52 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

A network of monitoring stations designed to detect large scale fluorescence emission in the atmosphere has been in operation for over two years. The motivation for the search arises from the prediction that an energetic photon burst would be produced in a supernova and this burst, when absorbed in the atmosphere, would produce fluorescence. This paper reports on observations up to February 1971. No supernova-like events have been found, although 4.4 were expected. One class of non-fluorescence events is described that evidence suggests is related to electrical discharge in the atmosphere. Another type of non-fluorescence pulse appears to be related to particle precipitation in the atmosphere. Author

N72-11726*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**CHARGE COMPOSITION OF SOLAR COSMIC RAYS**
D. L. Bertsch, C. E. Fichtel, and D. V. Reames *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 53-58 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

The composition of energetic solar particles is reviewed for all solar events in which measurements on helium and heavier nuclei have been made simultaneously in the same detector during a given particle event. For nuclei of equal charge-to-mass ratio, the relative abundances have been the same within uncertainties in every measurement, and consistent with spectroscopic photospheric estimates. Iron has a slightly different charge-to-mass ratio but is still of considerable interest. An observation of the Fe/O in the January 24, 1971 solar event has provided a second determination of this value. Author

N72-11727*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SOLAR PROTON, HELIUM, AND MEDIUM NUCLEI (Z IS EQUAL TO OR GREATER THAN 6 AND EQUAL TO OR LESS THAN 9) OBSERVED FROM THE IMP-6 SATELLITE**
T. T. VonRosenvinge, F. B. McDonald, and B. J. Teegarden *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 59-64 refs (See N72-11718 02-29)
Avail: NTIS CSCL 04A

Proton, helium, and medium nuclei energy spectra have been measured from the Explorer 35 satellite for a recent solar flare. Above 2 MeV/nucleon these spectra are based upon single and dual parameter pulse height analysis in addition to threshold rate counting. Pulse height analysis of medium nuclei is assigned a high priority for telemetry readout so that telemetry does not become saturated by the high proton intensity. In this manner the number of pulse height analyzed medium nuclei has been increased by a factor of approximately 200. Individual medium nuclei have been resolved in the energy interval 8 - 23 MeV/nucleon. Author

N72-11728*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**OBSERVATIONS OF THE SCATTER-FREE SOLAR-FLARE ELECTRONS IN THE ENERGY RANGE 20-1000 keV**
J. R. Wang, L. A. Fisk, and R. P. Lin (Calif. Univ., Berkeley) *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 65-70 refs (See N72-11718 02-29)
Avail: NTIS CSCL 03B

Observations of the scatter-free electron events from solar active region McMath No. 8905 are presented. The measurements were made on Explorer 33 satellite. The data show that more than 80% of the electrons from these events undergo no or little scattering and that these electrons travel only approximately 1.5 a.u. between the sun and the earth. The duration of these events cannot be accounted fully by velocity dispersion alone. It is suggested that these electrons could be continuously injected into interplanetary medium for a time interval of approximately 2 to 3 minutes. Energy spectra of these electrons are discussed. Author

N72-11729*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE NATURE OF RELATIVISTIC ELECTRON INTENSITY CHANGES DURING SOLAR FLARE QUIET TIMES BETWEEN 1963 AND 1969**
F. B. McDonald, T. L. Cline, and G. M. Simnett (Calif. Univ., Riverside) *In its* Goddard Space Flight Center Contrib. to the Twelfth Intern. Conf. on Cosmic Rays Nov. 1971 p 71-76 refs (See N72-11718 02-29)
Avail: NTIS CSCL 03B

Time variations of the 3-12 MeV interplanetary electron intensity, observed by the Explorer-18, -28, and -33 spacecrafts, have been studied in detail. Apart from solar flare effects, there are five distinct periods when the electron intensity has undergone a series of increases, and these are strongly correlated with solar rotation. The intensity increases are separate phenomena, and are strikingly anticorrelated with increases in the low energy solar proton intensity. The electron energy spectrum during those quiet-time increases is typically represented by $dJ/dE = k E/2.0 + or - 0.25$ similar to the galactic electron spectrum. There are, in addition, Forbush decreases in the electron intensity frequently coincident with those in the neutron monitor. It is concluded that these characteristics all support the hypothesis of a galactic origin for the electrons observed during quiet-time increases. Author

N72-11730*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ELECTRONS IN QUIET-TIME INCREASES, SAMPLERS OF CONDITIONS IN THE OUTER SOLAR SYSTEM** c30
L. A. Fisk and M. VanHollebeke *In its* Goddard Space Flight Center Contrib. to the Twelft Intern. Conf. on Cosmic Rays Nov. 1971 p 77-82 refs (See N72-11718 02-29)
Avail: NTIS CSCL 03B

An explanation for quiet-time electron increases is proposed which predicts as the existence of a modulating region for cosmic ray particles lying at approximately 30 AU from the Sun. Author

N72-11731# Los Alamos Scientific Lab., N.Mex.
**VELA 5 AND 6 SOLAR X-RAY ATLAS. 5: 1 SEPTEMBER 1970 TO 1 JANUARY 1971**
N. K. Blocker, W. H. Chambers, P. E. Fehlau, J. C. Fuller, W. E. Kunz, and R. W. Milkey Jun. 1971 124 p refs
(Contract W-7405-eng-36)
(LA-4454-Vol-5) Avail: NTIS

Data obtained form the solar radiation monitors on the Vela 5 and 6 satellites are presented. Equivalent graybody flux in three bands (0.3 to 3, 1 to 8, and 1 to 16A) is plotted as a function of universal time, one day per page. Author (NSA)

N72-11732# Emmanuel Coll., Boston, Mass. Physics Research Div.
**RESEARCH DIRECTED TOWARD STUDY OF COSMIC RAYS AND TRAPPED RADIATION Final Report, 1 Jan. 1966 - 31 Dec. 1970**
M. Patricia Hagan 31 Mar. 1971 127 p refs
(Contract AF 19(628)-5703; AF Proj. 8600)
(AD-724726; AFCRL-71-0162) Avail: NTIS CSCL 04/1

Studies were conducted and investigations directed toward the attainment of detailed information in regard to the presence of star producing events, heavy primaries, ionizing radiation, and other nuclear interactions occuring in emulsions exposed to this radiation at extremely high altitudes. In the interest of determining the intensities of low z components of the Primary Cosmic Radiation as a function of time of day, an experiment was designed, electronics assembled, and two identical units were constructed and calibrated for a July 1970 launch. The theory, design, electronics, and mechanical and pictorial representations are presented in this report. Author (GRA)

N72-11733# Washington Univ., St. Louis, Mo. Dept. of Physics.
**PRIMARY COSMIC RADIATION Final Report, 1 Jan. 1968 - 31 Dec. 1970**
Joseph Klarmann and M. W. Friedlander 1971 9 p
(Contract DA-ARO(D)-31-124-G988)
(AD-725608; AROD-2774-14-P) Avail: NTIS CSCL 04/1

During the three years ending January 1971 the major part of the cosmic ray program has been concerned with observations on ultraheavy primary particles, using very large area detectors exposed by means of high altitude balloons. Author (GRA)

N72-11741*# Translation Consultants, Ltd., Arlington, Va.
**A NEW TYPE OF SOLAR FLARE**
E. A. Gurtovenko *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 1-9 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

N72-11745*# Translation Consultants, Ltd., Arlington, Va.
**A SPECTRAL STUDY OF ACTIVE PROMINENCES**
E. A. Gurtovenko, N. N. Morozhenko, and A. S. Rakhubovskiy *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 36-56 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

N72-11761*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**COSMIC-RAY EFFECTS IN THE GUM NEBULA**

R. Ramaty and E. A. Boldt *In its* The Gum Nebula and Related Probl. Sep. 1971 p 97-109 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03B

N72-11768*# New Mexico Inst. of Mining and Technology, Socorro.
**THE DIFFICULTY OF ULTRAVIOLET EMSSION FROM SUPERNOVAE**
Stirling A. Colgate *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 163-165 (See N72-11750 02-30)
Avail: NTIS CSCL 03B

N72-11770*# Wisconsin Univ., Madison. Dept. of Physics.
**X-RAYS FORM THE VELA-PUPPIS COMPLEX**
A. N. Bunner *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1917 p 169-179 refs (See N72-11750 02-30)
(Grant NGL-50-002-044)
Avail: NTIS CSCL 03B

# 30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N72-11734*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**ESTIMATION OF MICROWAVE ABSORPTION IN THE JUPITER ATMOSPHERE**
William C. Coombs Sep. 1971 86 p refs
(NASA-TM-X-62091) Avail: NTIS CSCL 03B

A procedure for estimating the microwave absorption loss of the Jupiter atmosphere is presented. Estimation of microwave absorption by planetary atmospheres involves two different investigative disciplines (1) the determination of an acceptable model of the atmosphere itself and (2) the determination of the microwave attenuation rate applicable to each different volume sample of the atmosphere, and the integration of this loss over the varying radio propagation path for any given entry trajectory to obtain the total loss. Author

N72-11735# Joint Publications Research Service, Washington, D.C.
**SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 261**
1 Oct. 1971 24 p refs Transl. into ENGLISH from recent Sino-Soviet Bloc publ.
(JPRS-54174) Avail: NTIS

Soviet research projects in the fields of astronomy, meteorology, oceanography, and terrestrial geophysics are presented. Subjects discussed are: (1) adhesion and conglomeration of cosmic dust, (2) upper layer of soils covering the Martian surface, (3) forecasting of hail, thunderstorms, and showers, (4) oceanic circulation, and (5) drilling of a 15,000 meter well.
Author

N72-11736# European Space Vehicle Launcher Development Organization, Paris (France).
**ORBITAL NETWORK OPERATIONS REQUEST TRANSFER ORBIT**
[1971] 80 p
(ONOR-F11-Issue-1; DORO-F11-Issue-1) Avail: NTIS

The requirements for the F 11 mission which is the first launch of the Europa 2 four-stage vehicle are presented. The orbital network, tracking, telemetry, and facilities are described along with the organization and coordination. F.O.S.

N72-11737# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**STELLAR SPECTROMETRY IN THE 2-5 MICRON DOMAIN USING FOURIER TRANSFORMATIONS [SPECTROMETRIE STELLAIRE PAR TRANSFORMEE DE FOURIER DANS LE DOMAINE 2 A 5 MICRONS]**
Jean Laurent and Michel Portat 1971 15 p refs In FRENCH; ENGLISH summary Presented at the Intern. Symp. of Astrophys., Liege, 28-30 Jun. 1971
(ONERA-TP-984) Avail: NTIS

Selected star spectra are studied by an interferometric spectrometer to determine the properties of interstellar matter. The method consists of comparing two second recorded interferograms of reddened and non-reddened star spectra. In addition, photometric measurements at 2.5 and 4.5 microns are made. Resolution was on the order of 100. Author

N72-11738*# Techtran Corp., Glen Burnie, Md.
**THE MOON AT THE HANDS OF THE INVESTIGATORS [LA LUNE A L'HEURE DES ENQUETEURS]**
Michel Maurettes Washington NASA Nov. 1971 10 p Transl. into ENGLISH from Science et Avenir (France), no. 296, Oct. 1971 p 822-825 and 865-866
(Contract NASw-2037)
(NASA-TT-F-14062) Avail: NTIS CSCL 04B

An interview with a foreign NASA researcher concerning methods of investigating moon samples by different nations is presented. The study of the effects of solar radiation on lunar soils is emphasized. F.O.S.

N72-11739# Joint Publications Research Service, Washington, D.C.
**SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 263**
29 Oct. 1971 56 p Transl. into ENGLISH from Russian reports
(JPRS-54358) Avail: NTIS

The presented summary contains brief descriptions and abstracts of various scientific studies in astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. G.G.

N72-11740*# Translation Consultants, Ltd., Arlington, Va.
**ASTRONOMY AND ASTROPHYSICS. NO. 3: PROBLEMS OF ASTROPHYSICS**
A. F. Bogorodskiy, (ed.) Washington NASA Nov. 1971 109 p refs Transl. into ENGLISH of the publ. "Astrometriya i Astrofizika No. 3: Voprosy Astrofiziki" Kiev, Naukova Dumka, 1968
(Contract NASw-2038)
(NASA-TT-F-598) Avail: NTIS CSCL 03B

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N72-11741*# Translation Consultants, Ltd., Arlington, Va.
**A NEW TYPE OF SOLAR FLARE** c29
E. A. Gurtovenko *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 1-9 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

Unusually intense emission in the D sub 1, D sub 2 lines was registered photoelectrically in an undisturbed region near the center of the solar disk. Various aspects of the possibility that the emission is due to the processes of resonance scattering or fluorescence are analyzed using both natural and artificial comets. It is shown that the observed emission is of solar origin. The appearance of a spot group in the same place after its passage over the solar disk seems to indicate a connection between the sodium flares and the formation of an active region on the sun. Author

N72-11742*# Translation Consultants, Ltd., Arlington, Va.
**THE PROBLEM OF THE THERMAL EXPLOSION IN A DEGENERATE GAS** c24
V. V. Porfiryev and Yu. N. Redkoborodyy *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 10-12 refs (See N72-11740 02-30)
Avail: NTIS CSCL 20H

The processes of hydrogen burning in a stream of matter penetrating the degenerate nucleus of a white dwarf is considered. Author

N72-11743*# Translation Consultants, Ltd., Arlington, Va.
**A THEORY OF NONSTATIONARY NONADIABATIC SHOCK WAVES** c12
I. A. Klimishin *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 13-27 refs (See N72-11740 02-30)
Avail: NTIS CSCL 20D

The Chiznell-Wizem method, which permits finding approximate changes in parameters at the shock wave front, is generalized to account for energy losses attributable to ionization and radiation. These losses are estimated for the particular case of shock wave motion in the shell of a red giant. The case of isothermal shock waves is considered. It is shown that the velocity distribution of a shock wave in the atmosphere of an RR Lyrae type variable can be explained by a solution based on the assumption that the shock wave is not completely isothermal. Author

N72-11744*# Translation Consultants, Ltd., Arlington, Va.
**EXCITATION SOURCES IN THE CHROMOSPHERIC H ALPHA LINE**
R. I. Kostik and T. V. Orlova *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 28-35 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

The distribution of excitation sources in the chromosphere was determined from the observed contour of the H sub alpha line. Resonance scattering is the principle source of chromospheric excitation up to 3500 km below the photospheric level. Beginning from h = 5000 km, H sub alpha radiation results from intrinsic excitation sources only. Author

N72-11745*# Translation Consultants, Ltd., Arlington, Va.
**A SPECTRAL STUDY OF ACTIVE PROMINENCES** c29
E. A. Gurtovenko, N. N. Morozhenko, and A. S. Rakhubovskiy *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 36-56 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

The spectra of the active prominences of July 9 and 11, 1966 are analyzed. The physical conditions in these prominences are the same as in quiescent prominences, but their turbulent velocities are very high and are of the same order of magnitude as in limb flares. This microturbulence does not correspond to a normal velocity distribution. Author

N72-11746*# Translation Consultants, Ltd., Arlington, Va.
**INVESTIGATION OF RR LYRE TYPE VARIABLE STARS IN THE GLOBULAR CLUSTER M3**
E. S. Kheylo *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 57-78 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03A

RR Lyrae variables in M3 are studied. Seasonal movements of maxima and O-C diagrams of 12 RR Lyrae stars are given. Author

N72-11747*# Translation Consultants, Ltd., Arlington, Va.
**STELLAR ROTATION THEORY**
V. V. Porfiryev *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 79-91 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03A

Modern theory of the structure of rotating stars is reviewed. A hypothesis for noncircular stellar rotations is discussed. Author

N72-11748*# Translation Consultants, Ltd., Arlington, Va.
**INVESTIGATION OF INTERSTELLAR ABSORPTION AND DISTRIBUTION OF STARS IN THE REGION ALPHA (1950.0) EQUALS 19h22m, DELTA (1950.0) EQUALS PLUS 17 DEG**
V. I. Kuznetsov *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 92-97 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

Absorption and distribution of stars is investigated near the galactic equator at a fork in the Milky Way. Interstellar absorption is calculated for gamma sub pg = 4.0. The line of sight is shown as passing through the arm of Sagittarius and the maximum stellar density appears near the sun at distances of 100 to 300 parsecs. The luminosity function for this region is shown to agree with the luminosity function obtained elsewhere. Author

N72-11749*# Translation Consultants, Ltd., Arlington, Va.
**STRUCTURAL ANOMALIES OF THE MILKY WAY IN LONGITUDES 338-22 DEG**
V. I. Kuznetsov *In its* Astrometry and Astrophys. No. 3: Probl. of Astrophys. Nov. 1971 p 98-106 refs (See N72-11740 02-30)
Avail: NTIS CSCL 03B

The results of the investigations of references are generalized. The existence of a dust bridge between the spiral arms of Sagittarius and Carina-Cygnus is confirmed by data on the distribution of absorbing matter. The stellar arm of Sagittarius and hydrogen are compared, as is the spatial density of B8-A0 and A2-A5 stars with the density of the absorbing clouds. In general, an increase, or decrease in the density of the absorbing matter between the spiral arms of Sagittarius and Carina-Cygnus corresponds to the stellar density of B8-A0 and A2-A5 type stars. Author

N72-11750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE GUM NEBULA AND RELATED PROBLEMS**
Stephen P. Maran, John C. Brandt, and Theodore P. Stecher, (eds.) Sep. 1971 234 p refs Proc. of a Conf. held at Greenbelt, Md., 18 May 1971

(NASA-TM-X-65749; X-683-71-375) Avail: NTIS CSCL 03A

Papers were presented in conference sessions on the Gum nebula, the Vela X remnant, the hot stars gamma Velorum and zeta Puppis, the B associations in the Vela-Puppis complex, and pulsars. Ground-based optical and radio astronomy; rocket and satellite observations in the radio, visible, ultraviolet, and X-ray regions; and theoretical problems in the physical state of the interstellar medium, stellar evolution, and runaway star dynamics were considered. For individual titles, see N72-11751 through N72-11774.

N72-11751*# Maryland Univ., College Park. Astronomy Program.

**COLIN GUM AND THE DISCOVERY OF THE GUM NEBULA**

F. J. Kerr *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 1-4 refs (See N72-11750 02-30)

Avail: NTIS CSCL 03A

The research of Colin Gum in the field of astronomy is reviewed. It includes a radio survey at 200 MHz, a photographic survey for HII regions in the Southern Milky Way from longitude 220 deg to 20 deg, and a catalogue of 85 physically separate regions. He suggested that certain faint nebulosities were part of a large, nearby H II region excited by gamma Velorum and zeta Puppis. He was also concerned with 21-cm studies. K.P.D.

N72-11752*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**IDENTIFICATION OF THE GUM NEBULA AS THE FOSSIL STROEMGREN SPHERE OF THE VELA X SUPERNOVA**

John C. Brandt *In its* The Gum Nebula and Related Probl. Sep. 1971 p 5-11 refs (See N72-11750 02-30)

Avail: NTIS CSCL 03A

Evidence is presented for the production of the Gum nebula by the Vela X supernova, as opposed to its ionization by gamma Velorum and zeta Puppis. A model for the excitation of the nebula is proposed. K.P.D.

N72-11753*# Lockheed Missiles and Space Co., Palo Alto, Calif.

**THE SIZE AND SHAPE OF GUM'S NEBULA**

Hugh M. Johnson *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 12-21 refs (See N72-11750 02-30)

Avail: NTIS CSCL 03A

The ionizing light of the supernova which produced the Gum nebula is now fossilized in the still live, though failing, H II region. The main body of the nebula suggests a hollow center or shell form, with a characteristic radius of about half the distance to the outlying fragments. The edges of the main body patches are typically sharp and often bright. The structure of the Gum nebula appears to be dependent on the event of ionization and possibly on the details of heating. It is not now an unstructured ambient medium, as it may have been before the recent ionization. Several hypotheses are presented for a structured ambient medium. Author

N72-11754*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics and Center for Space Research.

**FORMATION OF GIANT H II REGIONS FOLLOWING SUPERNOVA EXPLOSIONS**

L. Sartori *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 22-33 refs (See N72-11750 02-30)

(Grants NGL-22-009-019; NSF GP-11453)

Avail: NTIS CSCL 03A

The principal optical properties of type I supernovae are summarized. These include the light curve and the spectrum. The spectra consist of broad bands with very little continuum. According to the theory presented, the observed light is principally fluorescence, excited in the medium surrounding the supernova by ultraviolet radiation originating from the explosion. It is proposed that the spectrum that impinges on the fluorescent medium while emission is taking place must fall abruptly across the Lyman edge of He II. Such a filtering action is plausibly provided by a much denser internal region, rich in helium, immediately surrounding the exploding object. This will form a Stromgren sphere during the time the intense UV pulse is passing through it. The dense region also slows down the photons below the edge by Thomson scattering, thereby spreading out the UV pulse in time. Various proposed mechanisms for the production of ionization in the Gum nebula are discussed. Author

N72-11755*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**RADIO ASTRONOMY EXPLORER-1 OBSERVATIONS OF THE GUM NEBULA**

J. K. Alexander *In its* The Gum Nebula and Related Probl. Sep. 1971 p 34-41 refs (See N72-11750 02-30)

Avail: NTIS CSCL 03A

Complicating factors in the spectrum analysis of the Gum nebula are discussed. These include accounting for the spectrum of supernova remnants in the direction of the nebula, the different absorption laws for radiation from beyond and within the nebula, and the Razin effect. This last results in a low frequency cutoff to the spectrum of synchrotron radiation by particles in a thermal plasma. These factors cause the observer to overestimate the amount of absorption occurring in the nebula. Data from the Explorer 38 satellite are presented for 3.93 and 6.55 MHz. Average optical depth for the nebula at 4 MHz was calculated. Author

N72-11756*# Maryland Univ., College Park. Astronomy Program.

**A DISCUSSION OF THE GROUND-BASED RADIO OBSERVATIONS**

F. J. Kerr *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 42-46 ref (See N72-11750 02-30)

Avail: NTIS CSCL 03A

It is reasserted that the Gum nebula is not a single nebula but appears to be composed of several different entities. All the surveys of the southern sky in the continuum, recombination line, H I, and OH were considered. The large amount of high frequency radio emission from the small nebula is noted. The outer part of the Gum nebula has not been seen in any radio observations so far. Only the inner part has been observed to date. It is not justifiable to work out any parameters for the whole nebula by taking an average over the whole solid angle subtended by the big nebula. There appears to be a large difference in density between the small nebula and the big one. Author

N72-11757*# Princeton Univ. Observatory, N.J.

**RUNAWAY STARS IN THE GUM NEBULA**

J. Richard Got, III and Jeremiah P. Ostriker *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 47-59 refs Sponsored in part by NSF (See N72-11750 02-30)

Avail: NTIS CSCL 03A

It is proposed that the two pulsars PSR 0833-45 (the Vela pulsar) and MP 0835 are runaways from a common binary system originally located in the B association around gamma Velorum. Arguments are presented for a simple model of the Gum nebula in which two distinct ionized regions are present. The first consists of the Stromgren spheres of gamma Velorum and zeta Puppis, while the second is a larger, more filamentary region ionized by the supernova explosion associated with PSR 0833-45. Using this model and the available dispersion measures, the distances to the two pulsars were estimated and found to be compatible with a runaway origin. The position angle of the rotation axis of PSR 0833-45 is also compatible with this origin. The masses of the parent stars of the two pulsars can be deduced from the runaway star dynamics and an assumed age for MP 0835. It is concluded that the masses were in excess of 10 solar masses. The dynamically-determined parent star masses

are in agreement with the values expected for evolved members of the B association around gamma Velorum. Author

N72-11758*# Harvard Coll. Observatory, Cambridge, Mass.
**STRUCTURE AND EVOLUTION OF FOSSIL H II REGIONS**
Richard McCray and Joseph Schwarz *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 60-72 refs Sponsored in part by NSF (See N72-11750 02-30)
Avail: NTIS CSCL 03A

The structure and evolution of a fossil H II region created by a burst of ionizing radiation from a supernova is considered. The cooling time scale for the shell is about 10 to the 6th power years. Superposition of million-year-old fossil H II regions may account for the temperature and ionization of the interstellar medium. Fossil H II regions are unstable to growth of thermal condensations. Highly ionized filamentary structures form and dissipate in about 10,000 years. Partially ionized clouds form and dissipate in about 10 to the 6th power years. Author

N72-11759*# New Mexico Inst. of Mining and Technology, Socorro.
**THE VELOCITY AND COMPOSITION OF SUPERNOVA EJECTA**
Stirling A. Colgate *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 73-79 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

In case of the Gum nebula, a pulsar - a presumed neutron star - is believed to be a relic of the supernova explosion. Regardless of the mechanism of the explosion, the velocity distribution and composition of the ejected matter will be roughly the same. The reimploding mass fraction is presumed to be neutron rich. The final composition is thought to be roughly 1/3 iron and 2/3 silicon, with many small fractions of elements from helium to iron. The termination of helium shell burning occurs because the shell is expanded and cooled by radiation stress. The mass fraction of the helium burning shell was calculated. Author

N72-11760*# Yeshiva Univ., New York. Belfer Graduate School of Science.
**COSMIC RAYS FROM SUPERNOVAE AND COMMENTS ON THE VELA X PRE-SUPERNOVA**
A. G. W. Cameron *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 80-96 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

A possible history of the production of elements in the galaxy is presented, based on assumptions about the end points of stellar evolution and of the general evolution of the galaxy. A wide range of quantities involving the relative abundances of nucleosynthesis products observed in the solar system, and various galactic quantities such as the current rate of supernova production and the present gas content of the galaxy, were considered. These assumptions were utilized in a computer program in which the gas content of the galaxy is gradually turned into stars. The stars are continually enriched in the products of nucleosynthesis as they approach the ends of their evolutionary lifetimes. It is suggested that supernova explosions are associated with the mass range of about 4-8 solar masses. Possible theories on the type of stellar explosive event represented by the Vela supernova are discussed. Author

N72-11761*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**COSMIC-RAY EFFECTS IN THE GUM NEBULA** c29
R. Ramaty and E. A. Boldt *In its* The Gum Nebula and Related Probl. Sep. 1971 p 97-109 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03B

The effects of low energy heavy nuclei from the supernova explosion on nearby interstellar space were investigated. In addition to the ionization and heating of the Gum nebula, these particles may produce detectable fluxes of X-rays and gamma rays, both as continuum radiation and line emission. Author

N72-11762*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics and Center for Space Research.
**THE EARLY EVOLUTION OF GIANT H II REGIONS FORMED BY SUPERNOVA EXPLOSIONS**
Minas C. Kafatos *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 110-127 refs (See N72-11750 02-30)
(Grants NGL-22-009-019; NSF GP-11453)
Avail: NTIS CSCL 03A

The evolution of a giant H II region, which cools after an initial ionization, is discussed. The discussion is applied to the Vela X and Tycho supernovae. Other giant H II regions might not be as easily detectable as the Vela X region. The Tycho region may be just detectable in the O(II) or O(III) optical lines or as a hole in the 21-cm emission line profiles, as is suggested in the data. These giant H II regions last appreciably longer than the continuum radio sources within them. Author

N72-11763*# California Univ., Los Angeles.
**THREE PROPOSED B-ASSOCIATIONS IN THE VICINITY OF ZETA PUPPIS**
Edward K. L. Upton *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 128-136 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

There appear to be three loose B associations in the general vicinity of zeta Puppis, all at distances of approximately 300 to 400 parsecs from the sun. Their diameters, perpendicular to the line of sight, are 20 to 50 parsecs, and their separations are of similar size. All three are situated in bright areas of the Gum nebula. The proposed associations A and C lie in the two brightest parts of the nebula. The three associations are not all of the same age. Association C is about 50 million years old, whereas A and B are decidedly younger. The ages of A and B cannot be determined from the present data, as their color-magnitude diagrams show no clear turnoff from the main sequence. Association A may be young enough to qualify as the birthplace of zeta Puppis. There is no other identifiable association in which zeta Puppis can have originated, unless its age is substantially greater than the 3 million years assumed. Author

N72-11764*# Boston Univ., Mass.
**COMMENTS ON AN ASSOCIATION IN VELA**
W. C. Straka *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 136-137 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

Evidence for an association near the Vela pulsar rests on the H-R diagram. Definite bunching occurs around the mean line. However this evidence is not supported by correlation of proper motions in the region. If the Vela pulsar is a member of this association, a rather large mass is implied; about 10 solar masses. Author

N72-11765*# Maryland Univ., College Park.
**A DISCUSSION OF THE H-ALPHA FILAMENTARY NEBULAE AND GALACTIC STRUCTURE IN THE CYGNUS REGION**
Thomas A. Matthews and S. Christian Simonson, III *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 138-148 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

From observation of the galactic structure in Cygnus, the system of filamentary nebulae was found to lie at a distance of roughly 1.5 kpc, in the same region as about half the thermal radio sources in Cygnus X, the supernova remnant near gamma Cygni, and the association Cygnus OB2, in the direction of which the X-ray source Cygnus XR-3 is observed. The source of

excitation was probably the pulse of radiation from a supernova explosion, as proposed in the case of Gum nebula. However continuing excitation by early stars in the region of Cygnus X cannot be excluded. Author

N72-11766*# Harvard Coll. Observatory, Cambridge, Mass.
**RADIOFREQUENCY RECOMBINATION LINES FROM THE INTERSTELLAR MEDIUM**
A. K. Dupree *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 149-157 refs (See N72-11750 02-30)
(Grant NGL-22-007-006)
Avail: NTIS CSCL 03A

Observations of recombination lines form normal H II regions, extended H II regions, nonthermal sources, and the H I medium are discussed. Detection of recombination lines from elements other than hydrogen may provide a means of identifying fossil Stromgren spheres at high temperature. Author

N72-11767*# Arizona Univ., Tucson.
**THE APPEARANCE OF THE GUM NEBULA**
Bart J. Bok *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 158-162 ref (See N72-11750 02-30)
Avail: NTIS CSCL 03A

The dimensions of the Gum nebula complex appear to be overestimated. The distance of 460 parsecs to the central pulsar is rather on the large side, and likely contributions from gamma Velorum and zeta Puppis were underestimated. The multiorigin character of the Gum nebula is reaffirmed. The parts produced by traditional ultraviolet thermal radiation and by processes directly related to the supernova outburst must be defined.
Author

N72-11768*# New Mexico Inst. of Mining and Technology, Socorro.
**THE DIFFICULTY OF ULTRAVIOLET EMSSION FROM SUPERNOVAE** c29
Stirling A. Colgate *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 163-165 (See N72-11750 02-30)
Avail: NTIS CSCL 03B

There are certain conceptual difficulties in the theory of the generation of ultraviolet radiation which is presumed for the creation of the optical fluorescence mechanism of supernova light emission and ionization of a nebula as large as the Gum nebula. Requirements concerning the energy distribution of the ultraviolet photons are: 1) The energy of the greater part of the photons must be sufficient to cause both helium fluorescence and hydrogen ionization. 2) If the photons are emitted in an approximate black body spectrum, the fraction of energy emitted in the optical must be no more than what is already observed. Ultraviolet black body emission depends primarily on the energy source. The probability that the wide mixture of elements present in the interstellar medium and supernova ejecta results in an emission localized in a limited region with less than 0.001 emission in the visible, for either ionization or fluorescence ultraviolet, is remote. Therefore transparent emission must be excluded as unlikely, and black body or at least quasi-black-body emission is more probable. Author

N72-11769*# Wisconsin Univ., Madison.
**A NOTE ON THE POSSIBLE IMPORTANCE OF THE GUM NEBULA**
D. P. Cox *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 166-168 (See N72-11750 02-30)
Avail: NTIS CSCL 03A

Reasons for considering the Gum nebula a fossil H II region are presented. Arguments for different types of fossil regions are given. Possible research projects are enumerated. K.P.D.

N72-11770*# Wisconsin Univ., Madison. Dept. of Physics.
**X-RAYS FORM THE VELA-PUPPIS COMPLEX** c29
A. N. Bunner *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1917 p 169-179 refs (See N72-11750 02-30)
(Grant NGL-50-002-044)
Avail: NTIS CSCL 03B

A review of X-ray observations in the vicinity of the Gum nebula is presented. There is little doubt that the filamentary nebula Stromlo 16, the radio source Vela X, and the extended X-ray object Vel XR-2 are indications of the same, relatively nearby, supernova remnant. X-ray absorption measurements are consistent with a distance of 500 + or - 100 pc. The observed X-ray spectra have not yet distinguished between thermal bremsstrahlung and synchrotron radiation as the source mechanism. A search for low energy X-ray emission lines, both within the 5 deg diameter remnant and in the larger Gum nebula, may provide an important test for models of supernova remnant evolution. Author

N72-11771*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE BASIC ASSUMPTION**
Theodore P. Stecher *In its* The Gum Nebula and Related Probl. Sep. 1971 p 180-181 (See N72-11750 02-30)
Avail: NTIS CSCL 03A

When a supernova occurs, there is a release of sufficient energy to ionize a large amount of the surrounding material. The Gum nebula is an example of this process. Author

N72-11772*# Wisconsin Univ., Madison. Physics Dept.
**LOW INTENSITY H-BETA EMISSION FROM THE INTERSTELLAR MEDIUM**
R. J. Reynolds, F. Roesler, F. Scherb, and E. A. Boldt (NASA. Goddard Space Flight Center, Greenbelt, Md.) *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 182-209 refs (See N72-11750 02-30)
(Grant NGL-50-002-044; NGL-50-002-162)
Avail: NTIS CSCL 03A

A search for diffuse galactic H beta emission not associated with any known H II regions was conducted using a 2-inch-diamenter pressure-scanned Fabry-Perot spectrometer at the Coude focus of a 36-inch telescope. Observations were made near the directions of four pulsars. Emissions with intensities from 40,000 to 400,000 photons/sq cm sec ster (corresponding to emission measures of approximately 10 - 100) were detected in three of the directions. The data indicate an average ionization rate (assuming steady state) of approximately 10 to the minus 14th power/H-atom sec for the interstellar hydrogen in these directions and temperatures between 1000 and 10,000 K for the emitting regions. Plans were made to continue the investigation of these very faint hydrogen emission sources using a 6-inch-diameter Fabry-Perot spectrometer.
Author

N72-11773*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LARGE NEBULAR COMPLEXES IN THE NORTHERN PORTION OF THE GALAXY**
William J. Webster, Jr. (NAS-NRC, Washington, D. C.) *In its* The Gum Nebula and Related Probl. Sep. 1971 p 210-219 refs (See N72-11750 02-30)
Avail: NTIS CSCL 03A

Several northern complexes of ionized hydrogen, stars, and possibly nonthermal radio emission are known whose properties are similiar to those of the Gum nebula. Among the best known complexes are the Ori I and Ceph IV associations and IC 1795, IC 1805, and IC 1848. Each of these complexes contains an extended ring structure and requires more excitation than is available from the known early stars. The properties of these objects were examined and many of the properties of the Gum nebula are common to such galactic complexes. Author

N72-11774*# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service d'Aeronomie.
**PRELIMINARY RESULTS ON AN H-ALPHA MAP OF THE GUM NEBULA OBTAINED WITH THE D-2-A SATELLITE**
J. E. Blamont and A. C. Levasseur *In* NASA. Goddard Space Flight Center The Gum Nebula and Related Probl. Sep. 1971 p 220-228 (See N72-11750 02-30)
Avail: NTIS CSCL 03A

Hydrogen emissions, including telluric H alpha, in the terrestrial atmosphere were studied. The H alpha experiment was designed to use a monochromatic photometer that would provide measurements of weak H alpha emission originating at altitudes of a few hundred or thousand km, free of contamination by other telluric emissions. The Gum nebula was recorded by the instrument as a much more intense feature than the geocoronal emission. The spacecraft employed and the optical onboard equipment are described. Field of view, spectral response, absolute calibration, linearity, and inflight performance are discussed. Author

N72-11775*# North American Rockwell Corp., Downey, Calif. Space Div.
**IN-SPACE PROPELLANT LOGISTICS AND SAFETY First Performance Review, 26 Jun. - 15 Sep. 1971**
6 Oct. 1971 79 p
(Contract NAS8-27692)
(NASA-CR-121027; DPD-262; DR-MA-03) Avail: NTIS CSCL 22A

Preliminary guidelines for the basic delivery system and safety aspects of the space shuttle configuration in connection with the transport, handling, storage, and transfer of propellants are developed. It is shown that propellants are the major shuttle space load and influence shuttle traffic modeling significantly.
G. G.

N72-11776# Technische Hochschule Munchen (West Germany). Inst. fuer Astron. und Phys. Geodaesie.
**THEORY OF SATELLITE ORBITS, PART 3 [THEORIE DER SATELLITENBAHNEN, TEIL 3]**
Manfred Schneider Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Aug. 1971 172 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-71-38) Avail: NTIS; ZLDI Munich: 37,50 DM

Lagrange's planetary equations are solved for a satellite moving in a noncentral gravitational field of the central body. A mainly orientating perturbation calculation is conducted. The perturbing field is assumed to be the anisotropy of the gravitational field. A general scheme is given for the solution of the perturbation equations in classical orbital elements. The perturbation calculation is then performed in first approximation.
ESRO

N72-11777# Kitt Peak National Observatory, Tucson, Ariz.
**EXTENDED IMAGE SCANNER WITH COMPENSATION FOR ATMOSPHERIC NOISE**
Peter Vokac 21 Oct. 1971 21 p
(Grant NSF C-400)
(PB-200456; NSF-71-33-C-400) Avail: NTIS CSCL 03A

A device is described that was designed for observation of Mars from a telescope on the ground controlled by a mini-computer. It has no moving parts and all of the optical elements and some of the electronic servoelements are located in a box affixed to a telescope. Author (GRA)

N72-11778# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
**APERTURE SYNTHESIS STUDY OF NEUTRAL HYDROGEN IN THE GALAXY M101. 1: OBSERVATIONS. 2: DISCUSSION**
D. H. Rogstad and G. S. Shostak 1971 50 p refs
(Contract N00014-67-A-0094-0019)
(AD-727578; Rept-1971-7) Avail: NTIS CSCL 03/2

Synthesis observations of neutral hydrogen emission in the spiral galaxy M101 obtained with the Owens Valley twin-element interferometer are presented. The spatial resolution is 4 sec. of arc, and the velocity resolution is 21 km/s. The observations are given in the form of contour maps of the integral and the mean velocity of the H I profile at each position in the galaxy, and a line profile for the galaxy as a whole. A contour map of the 21 cm continuum radiation is also presented. The observations described in another paper (Rogstad and Shostak, 1971) are discussed with the following conclusions: There is a close correspondence between features in the surface density of both light and H I in the galaxy M101. The H I velocity field contains streaming motions which are in agreement with the predictions of the first-order density wave theory of spiral structure. There is evidence for expansion motions of at least 40 km/s in the central region of the galaxy. Author (GRA)

N72-11779# California Inst. of Tech., Pasadena.
**TWO-DIMENSIONAL STRUCTURES OF 76 EXTRA-GALACTIC RADIO SOURCES AT 1425 MHz**
E. B. Fomalont 1971 42 p refs
(Contract N00014-67-A-0094-0019)
(AD-726485; Rept-1971-4) Avail: NTIS CSCL 03/2

The two-dimensional structures of 76 extragalactic radio sources at a frequency of 1425 MHz are given. All of the observations were made using the Owens Valley Radio Observatory twin-element interferometer with a resolution of 45 seconds in the east-west direction and 45 seconds (delta-37 degrees) in the north-south direction. The inversion of the interferometric data was obtained using a model fitting technique. The structure for each source and the optical identification are given in tabular and graphical form. Author (GRA)

N72-11780# Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Physics Lab.
**OBSERVATIONS OF THE GALACTIC SPUR AND THEIR INTERPRETATION, MARCH - APRIL 1967**
Donald A. Guidice 5 Mar. 1971 57 p refs
(AF Proj. 4643)
(AD-726529; AFCRL-71-0170; AFCRL-ERP-349) Avail: NTIS CSCL 03/2

An investigation of the brightness temperature distribution of the Galactic Spur in the Northern Hemisphere was made at 38, 75, 33, 45, 26, 70, and 22.30 MHz, using the 1000-ft radio telescope of the Arecibo Ionospheric Observatory. These observations supersede the very limited observations taken at Arecibo the previous year. Descriptions of the observations and the data analysis are given. Contour maps of the Galactic Spur (corrected antenna temperature and brightness temperature) for the four frequencies are presented, covering the celestial region alpha = 12h to 18h delta = 0 to +35 deg. The rainbow, the minor spiral arm, and the supernova remnant theories of the Spur's origin are discussed. Significant evidence supporting the supernova remnant theory was found. The Spur's bright radiation belt was found geometrically to be part of a small circle (and not of a great circle) having an arc-length of nearly 270 deg. The Spur's spectrum is comparable with other supernova remnants. The outside edges of radial profiles across the Spur's ridge structure are at least two times steeper than the inside edges, highly indicative of a shell source. Author (GRA)

N72-11781# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Library Section.
**THEORY AND PRACTICAL DETERMINATION OF THE ORBIT OF AN ARTIFICIAL EARTH SATELLITE [THEORIE ET DETERMINATION PRATIQUE DE L'ORBITE D'UN SATELLITE ARTIFICIEL DE LA TERRE]**
J. C. Blaive May 1971 31 p Transl. into ENGLISH from French report
(AD-724936; ACIC-TC-1732) Avail: NTIS CSCL 22/3

The report defines in broad outlines the theory of the motion of an artificial earth satellite and the method of the practical determination of an orbit. A brief review is given of the

various disturbing forces acting on the satellite, the earth's potential, lunisolar potential, atmospheric drag, and radiation pressure, as well as the principle of the method of solving the equations of motion. The various means of tracking satellites are examined, with special stress on interferometric methods. The principle of practical determination of an orbit with the aid of interferometric measurements and the practical and theoretical purposes for observing satellites are given. Author (GRA)

N72-11782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ACADEMICIAN S. P. KOROLEV, BIOGRAPHY**
P. T. Astashenkov Mar. 1971 282 p refs Transl. into ENGLISH from the Monograph "Akademik S. P. Korolev" 1969 p 1-208
(FTD Proj. 6010507)
(AD-724978; FTD-HC-23-542-70; DIA-Task-T65-01-21A) Avail: NTIS CSCL 05/9

The book is a bibliography of Sergey Pavlovich Korolev 1906-1966, a pioneer in the development of Soviet Rocket Technology. GRA

N72-11783# Texas Univ., Dallas. Div. of Mathematics and Mathematical Physics.
**EXACT SOLUTIONS OF EINSTEIN'S FIELD EQUATIONS Final Report, 1 Apr. 1967 - 31 Mar. 1971**
Michel Cahen, Istvan Ozsvath, Wolfgang Rindler, and Ivor Robinson 31 Mar. 1971 17 p refs
(Grant AF-AFOSR-903-67; AF Proj. 9767)
(AD-725778; AFOSR-71-1816TR) Avail: NTIS CSCL 20/10

The final report covering the research performed under the Air Force Office of Scientific Research by the Dallas relativity group, summarizes information on personnel involved, on the scientific work done, and on the results obtained in the four years of the grant's duration. Topics investigated were in areas of General relativity, cosmology, and electrodynamics. GRA

N72-11784# Aeronautical Chart and Information Center, St. Louis, Mo. Research Div.
**SECULAR PERTURBATIONS IN THE ELEMENTS OF THE EARTH'S ORBIT AND ASTRONOMICAL THEORY OF CLIMATE VARIATIONS [VEKOVYYE IZMENENIYA ELEMENTOV ORBITY ZEMLII ASTRONOMICHESKAYA TEORIYA KOLEBANII KLIMATA]**
Sh. G. Sharaf and N. A. Budnikova May 1971 67 p refs Transl. into ENGLISH from Tr. Inst. Teor. Astron., Leningrad, USSR, v. 14, 1969 p 48-84
(AD-725786; ACIC-TC-1681) Avail: NTIS CSCL 03/3

The present paper deals with the astronomical theory of climate variations. The tables of secular perturbations in the earth's orbital elements for 3,000,000 years time interval backward and 1,000,000 years time interval forward from the epoch 1950.0 are given. The secular course of the solar radiation (in canonical units) in the earth's latitude 65 degrees north and south is illustrated since 1950.0 and in the form of the diagrams for the past 30,000,000 years and the future 1,000,000 years, the equivalent latitudes being used instead of the radiation values in canonical units. The problem of temperature changes due to the variations in solar radiation arriving at the earth's surface is discussed, only the influence of celestial-mechanic factors on the sun's radiation being considered.
Author (GRA)

N72-11730*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ELECTRONS IN QUIET-TIME INCREASES, SAMPLERS OF CONDITIONS IN THE OUTER SOLAR SYSTEM**
L. A. Fisk and M. VanHollebeke *In its* Goddard Space Flight Center Contrib. to the Twelft Intern. Conf. on Cosmic Rays Nov. 1971 p 77-82 refs (See N72-11718 02-29)
Avail: NTIS CSCL 03B

# 31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N72-11785*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
**TNT EQUIVALENCY STUDY FOR SPACE SHUTTLE (EOS). VOLUME 1: MANAGEMENT SUMMARY REPORT Final Report**
R. R. Wolfe 30 Sep. 1971 18 p
(Contract NASw-2129)
(NASA-CR-123370; ATR-71(7233)-4-Vol-1) Avail: NTIS CSCL 22B

The existing TNT equivalency criterion for LO2/LH2 propellant is reevaluated. It addresses the static, on-pad phase of the space shuttle launch operations and was performed to determine whether the use of a TNT equivalency criterion lower than that presently used (60%) could be substantiated. The large quantity of propellant on-board the space shuttle, 4 million pounds, was considered of prime importance to the study. A qualitative failure analysis of the space shuttle (EOS) on the launch pad was made because it was concluded that available test data on the explosive yield of LO2/LH2 propellant was insufficient to support a reduction in the present TNT equivalency value, considering the large quantity of propellant used in the space shuttle. The failure analysis had two objectives. The first was to determine whether a failure resulting in the total release of propellant could occur. The second was to determine whether, if such a failure did occur, ignition could be delayed long enough to allow the degree of propellant mixing required to produce an explosion of 60% TNT equivalency since the explosive yield of this propellant is directly related to the quantities of LH2 and LO2 mixed at the time of the explosion. Author

N72-11786*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
**TNT EQUIVALENCY STUDY FOR SPACE SHUTTLE (EOS). VOLUME 2: TECHNICAL DISCUSSION Final Report**
R. R. Wolfe 30 Sep. 1971 108 p refs
(Contract NASw-2129)
(NASA-CR-123371; ATR-71(7233)-4-Vol-2) Avail: NTIS CSCL 22B

FOR ABSTRACT SEE N72-11785

N72-11787*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
**TNT EQUIVALENCY STUDY FOR SPACE SHUTTLE (EOS). VOLUME 3: APPENDICES Final Report**
R. R. Wolfe 30 Sep. 1971 50 p refs
(Contract NASw-2129)
(NASA-CR-123372; ATR-71(7233)-4-Vol-3-App) Avail: NTIS CSCL 22B

For Abstract SEE N72-11785

N72-11788# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**APPLICATION OF THE LINEAR FILTERING TECHNIQUES TO THE ATTITUDE RESTITUTION OF SPINNING SATELLITES [APPLICATION DES TECHNIQUES DE FILTRAGE LINEAIRE A LA RESTITUTION D'ATTITUDE D'UN SATELLITE EN ROTATION]**
Huynh Huu Thanh 1971 8 p refs Presented at the 4th Congr. of the IFAC, Dubrovnik, 6-10 Sep. 1971
(Contract ESTEC-1179/70AP)
(ONERA-TP-953) Avail: NTIS

The numerical results of a computer simulation, aimed at verifying the attitude restitution of a satellite spinning around its axis of revolution, are given. Through the use of Kalman filters, it

was shown that it is possible to distinguish the actual attitude angles from systematic discrepancies due to sensors. The influence of model errors is also examined. Author

N72-11789*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DESCRIPTION OF SCIENTIFIC EXPERIMENTS ORBITING GEOPHYSICAL OBSERVATORY MISSION 6**
F. J. Liberatore (comp.) May 1971 150 p
(NASA-TM-X-65733; X-420-69-201) Avail: NTIS CSCL 22C

The instrumentation and objectives of the scientific experiments to be conducted during the OGO-F mission are briefly described. A.L.

N72-11790*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**STATISTICS CONCERNING THE APOLLO COMMAND MODULE WATER LANDING, INCLUDING THE PROBABILITY OF OCCURRENCE OF VARIOUS IMPACT CONDITIONS, SUCESSFUL IMPACT, AND BODY X-AXIS LOADS**
Arthur M. Whitnah and David B. Howes Washington Nov. 1971 34 p refs
(NASA-TM-X-2430; MSC-S-255) Avail: NTIS CSCL 22C

Statistical information for the Apollo command module water landings is presented. This information includes the probability of occurrence of various impact conditions, a successful impact, and body X-axis loads of various magnitudes. Author

N72-11791*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VALIDATION OF SERT 2 THERMAL ANALYTICAL TECHNIQUES BY THERMAL VACUUM TESTING OF THE PROTOTYPE SATELLITE**
George R. Smolak and N. John Stevens Washington Nov. 1971 47 p refs
(NASA-TN-D-6421; E-6396) Avail: NTIS CSCL 22B

The thermal protection system for the flight configuration of the SERT 2 satellite was designed using an analytical thermal network to represent the satellite and its environment. A large part of this digital analytical network was adjusted and calibrated by comparing predicted temperatures with experimental measurements made with the prototype SERT 2 satellite in an extended thermal vacuum test. The procedures used in adjusting and calibrating the analytical network are outlined. Author

N72-11792*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VORTEX BREECH HIGH PRESSURE GAS GENERATOR Patent Application**
James E. Pleasants and Viggo G. Dereng, inventors (to NASA) Filed 22 Jan. 1971 18 p
(NASA-Case-LAR-10549-1; US-Patent-Appl-SN-108824) Avail: NTIS CSCL 22B

The design and development of a gas generator to be used in deploying a recovery parachute from a space capsule during reentry is discussed. A vortex breech is employed with the gas generator to separate unburned propellant particles from the high pressure gases to preclude damage to the recovery parachute. Author

N72-11793*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SPACE VEHICLE WITH ARTIFICIAL GRAVITY AND EARTH-LIKE ENVIRONMENT Patent Application**
Vernon H. Gray, inventor (to NASA) Filed 30 Aug. 1971 17 p
(NASA-Case-LEW-11101-1; US-Patent-Appl-SN-175983) Avail: NTIS CSCL 22B

A space vehicle which provides an artificial gravity and earthlike atmospheric environment for occupants is described. The vehicle is comprised of a cylindrically-shaped, hollow pressure-tight body, one end of which is tapered from the largest diameter of the body, the other end being flat and transparent to sunlight. The vehicle is provided with thrust means which rotate the body about its longitudinal axis, generating an artificial gravity effect upon the interior walls due to centrifugal forces. Sunlight is directed into the interior of the body through the transparent end by means of a mirror which is oriented independently of the rotation of the body. The sunlight is dispersed to the internal surfaces of the body by means of concentric reflecting and deflecting rings. The walls are lined with soil and provided with an initial supply of plants and livestock. The controlled climate and sunlight provide an earthlike environment is which the carbon dioxide/oxygen balance is maintained, and food is supplied through a natural system of plant life. Waste products are treated hygienically and returned to the soil to serve as fertilizers. NASA

N72-11794*# Martin Marietta Corp., Denver, Colo.
**PRELIMINARY DESIGN OF A SHUTTLE DOCKING AND CARGO HANDLING SYSTEM: CONCEPT REVIEW AND SELECTION**
16 Aug. 1971 54 p
(Contract NAS9-11932)
(NASA-CR-115240) Avail: NTIS CSCL 22B

The preliminary design of a space shuttle docking and cargo handling system is presented. Subjects discussed are: (1) general requirements, (2) alternative concepts, (3) subsystem requirements, (4) time series analysis, and (5) mission planning. Author

N72-11795# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
**INFLUENCE OF MISSION AND DESIGN PARAMETERS ON THE APPLICATION OF RAMJET ROCKETS FOR LOW ALTITUDE MISSILES [UEBER DEN EINFLUSS VON MISSIONS- UND AUSLEGUNGSPARAMETERN AUF DIE ANWENDUNG VON STAUSTRAHLRAKETEN BEI BODENNAHEN FLUGKOERPERN]**
E. Riester 1971 31 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-58) Avail: NTIS; DFVLR, Porz, West Ger.: 9 DM

Second stage and solid propellant rocket engines were compared for low altitude missiles with initial acceleration based on a number of engine design, velocity, and range parameters. It is found, that the superiority of the ramjet rocket for short-time propulsion largely depends on the possiblity of its lightweight construction. Especially for short-range missions, it is advantageous to end booster propulsion before reaching cruising speed, and to transfer the residual acceleration to the ramjet engine. The superiority of the ramjet rocket increases with range. ESRO

N72-11796# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CERTAIN PROBLEMS IN DESIGNING SPACE VEHICLES WITH TRIAXIAL ORIENTATION**
I. M. Lisovich and G. Yu. Maksimou 19 Feb. 1971 16 p Transl. into ENGLISH from Akademiya Nauk. Institut Kosmicheskikh Issledovanii, Moscow (USSR), 1970 p 1-16
(AF-c206 Proj.)
(AD-724991; FTD-HT-23-900-70) Avail: NTIS CSCL 22/2

The article investigates certain aspects in the design of space vehicles which use a flat solar battery for their power generator and a narrow-beam parabolic antenna for two-way radio communication with Earth. To assure that the solar batteries will be directed toward the Sun and the parabolic antenna toward the Earth a triaxial orientation system (Sun-object-Earth or Sun-object-star) is used. The authors discuss optimal arrangement of transmitters and engine, limitations of the Sun-object-Earth orientation, and advantages of the more universal Sun-object-star system. Author (GRA)

# 32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

**N72-11797** National Lending Library for Science and Technology, Boston Spa (England).
**THE KINETICS OF CRACK DEVELOPMENT IN VISCO-ELASTIC MATERIALS [KINETYKA ROZVYTKU TRISHCHYN U VYAZKO-PRUZHNYKH MATERIALAKH]**
A. O. Kaminskii Oct. 1971 5 p refs Transl. into ENGLISH from Dopov. Akad. Nauk Ukr. RSR, Ser. A, Fiz. Mekh. Mat. Nauki (Ukrainia SSR), v. 30, no. 9, 1968 p 856-860
(NLL-RTS-6690) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.50; 2 NLL photocopy coupons

A study is made of crack development in visco-elastic media and an expression is obtained for the stability of the ends of cracks in visco-elastic bodies. Based on this expression, analytical formulas are found for calculating the velocity at the ends of cracks in an infinite strip from visco-elastic material. This method does not require the introduction of new material constants in order to characterize the fractured material. Author

**N72-11798** National Lending Library for Science and Technology, Boston Spa (England).
**ULTRASONIC TESTING OF SEAMLESS HIGH TEMPERATURE STEEL TUBES**
6 Sep. 1971 5 p Transl. into ENGLISH from "Stahl-Eisen Profblaetter des Vereins Deutscher Eisenhuttenleute 1915-1965" Duesseldorf, Jan. 1965
(NLL-CE-Trans-5669-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

An ultrasonic tube testing method is used for detecting defects disposed predominantly in the longitudinal direction. The indication given by the ultrasonic test device when irradiating the tube under inspection is compared with the indication obtained when irradiating a length of tube the inside and outside walls, each with an artificial longitudinal defect of a given size. This sheet covers the testing of straight seamless tubes (not bends) in heat resisting steels with O.D. less than or equal to 20 mm and thickness less than or equal to 2 mm. Author

**N72-11799** National Lending Library for Science and Technology, Boston Spa (England).
**RESEARCH WORK ON THE CONTINUOUS MONITORING OF CRACK EXTENSION IN PRESSURE VESSELS. PART 2: FURTHER INVESTIGATIONS IN RESPECT OF THE ACOUSTIC WAVES EMITTED DURING CRACK EXTENSION**
J. Eisenblatter 28 Jul. 1971 52 p Transl. into ENGLISH from the German
(NLL-Risley-Tr-2161-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 NLL photocopy coupons

The research is reported in the development and application of very broadband probes of lithium sulphate, and resonance probes with high thermal resistance, for measuring acoustic emission during crack propagation. Acoustic emission signals were recorded during measurements on notched fracture mechanics speciments for amplitude load cycles, and during tensile tests following the production of fatigue cracks. High acoustic pulse rates were observed only during slow, ductile tearing, and the magnitude was dependent on the speed at which the crack propagated. It was also found that during internal pressure tests on notched steel tubes, ductile crack growth prior to brittle fracture was indicated by an increase in the acoustic pulse rate. F.O.S.

**N72-11800** Rensselaer Polytechnic Inst., Troy, N.Y.
**THE TRANSMISSION OF TORQUE THROUGH A COMPOSITE PLATE-SHELL STRUCTURE Ph.D. Thesis**
John Winslow Gough 1970 257 p
Avail: Univ. Microfilms Order No. 70-19938

A number of plate and shell solutions were generated to determine the influence of torque on shell structures. Sinusoidally distributed line loads applied along a generator of thin circular cylindrical shells are considered. Closed form solutions are generated to the homogeneous form of Morley's equation by treating the shell as if it were split along the loaded generator and imposing boundary conditions to the resulting edges. These conditions introduce a discontinuity in an appropriate edge loading, across the split, equal to the applied loading while requiring continuity of the remaining edge loads and displacements. The types of loading which are considered include axial, tangential, and circumferential-moment loading. The mth order sinusoidal form is assumed for all loadings. Simply supported end conditions are assumed in all cases, but the effects of permitting the ends to rotate with respect to each other are considered in addition to solutions requiring zero rotation.
Dissert. Abstr.

**N72-11801#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**EVALUATION OF DISSIPATION AND DAMAGE IN METALS SUBMITTED TO DYNAMIC LOADING [EVALUATION DE LA DISSIPATION ET DE L'ENDOMMAGEMENT DANS LES METAUX SOUMIS A DES SOLLICITATIONS DYNAMIQUES]**
Jean Lemaitre 1971 16 p refs In ENGLISH and FRENCH Presented at the Intern. Conf. on the Mech. Behavior of Mater., Kyoto, 15-20 Aug. 1971
(ONERA-TP-994) Avail: NTIS

An extension of validity of quasi-static isotropic viscoplastic constitutive equations is proposed for problems dealing with dissipation and fatigue damage in metals. Viscoplastic strain energy density is calculated in the case of cyclic loading and used to express internal damping. Fatigue damage may be expressed in terms of this energy and the Manson-Coffin relation can be derived from this concept. A new damage law of functional energy is proposed to unify different criteria and to predict rupture phenomenon in general case of loading. Author

**N72-11802*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EFFECTS OF LOADING SEQUENCE FOR NOTCHED SPECIMENS UNDER HIGH-LOW TWO-STEP FATIGUE LOADING**
John H. Crews, Jr. Washington Nov. 1971 26 p refs
(NASA-TN-D-6558; L-7915) Avail: NTIS CSCL 20K

The effects of loading sequence on crack-initiation period were investigated for notched aluminum-alloy specimens under high-low two-step loading with special emphasis on local cyclic stresses and strains at the notch root. Local stress and strain were determined by a procedure based on an equation proposed by Neuber which relates elastoplastic stress and strain at a notch. Local stress and strain were also measured experimentally to verify the Neuber equation. The effects of initial high load on the crack-initiation periods were demonstrated with notched specimens and were simulated in unnotched specimens fatigue tested with local stress sequences. An analysis of the results indicated that sequence effects were not caused solely by local residual stresses, as is usually assumed; the existence of a damaging effect, resulting from the high local strain cycles, was demonstrated. The sequence effects observed with notched specimens were interpreted as the combined result of residual stresses and high local strain cycles. Author

**N72-11803*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ELECTRONIC STRAIN LEVEL COUNTER Patent Application**
Felix L. Pitts and John L. Spencer, inventors (to NASA) Filed

8 Jul. 1971 12 p
(NASA-Case-LAR-10756-1; US-Patent-Appl-SN-160859) Avail: NTIS CSCL 20K

An electronic strain-level counter for obtaining structural strain data on in-flight aircraft is described. The device counts the number of times the strain at a point on a structural member of the aircraft exceeds each of several preset levels. A dead band is provided at each level to prohibit the counting of small strain variations around a given preset level. NASA

N72-11804# Bendix Corp., Kansas City, Mo.
**COMPRESSION PLATENS FOR LOAD VERSUS DEFLECTION TESTING OF SILICONE ELASTOMERS** Interim Report
Jul. 1971 15 p
(Contract AT(29-1)-613)
(BDX-613-374; PDO-6984549) Avail: NTIS

Silicone elastomer cushions were subjected to load versus deflection tests to define the correlation between 2.000-inch- and 1.129-inch-diameter compression platens. The test description and results are presented in graphic form. Analysis indicates that a significant correlation exists and that the 1.129-inch-diameter platen may be considered an adequate replacement for the 2.000-inch-diameter platen. Author

N72-11805# Oak Ridge National Lab., Tenn.
**EFFECT OF FILLETS ON STRESS CONCENTRATIONS IN CYLINDRICAL SHELLS WITH STEP CHANGES IN OUTSIDE DIAMETER**
R. C. Gwaltney, J. M. Corum, and W. L. Greenstreet 10 Feb. 1971 7 p refs Presented at 1st Natl. Congr. on Pressure Vessels and Piping, San Francisco, 10-12 May 1971 Sponsored by AEC
(Conf-710512-15; Rept-71-PVP-27) Avail: NTIS

The effect of varying the radii of circumferential fillets in the transition region of cylindrical shells with a step change in outside diameter and loaded with internal pressure was examined by means of finite element analyses for 27 models. Parameters studied were ratios of the thickness of the thicker section to the thickness of the thinner section, ratios of the fillet radius to thickness of the thinner section, and ratios of the inside radius of the cylindrical shell to the thickness of the thinner section. Comparisons are presented between experimental and theoretical results for two experimental models, and duplicate analyses for two cases were made with different computer programs for comparison purposes. Author (NSA)

N72-11806# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Statik und Stahlbau.
**CALCULATION OF PLANAR AND SPATIAL STRUCTURES USING A METHOD OF VARIATION OF FORCES AND DISPLACEMENTS ACCORDING TO A GENERAL THEORY OF SMALL DISPLACEMENTS IN MATRIX NOTATION. THEORETICAL PRINCIPLES FOR PAS [ZUR BERECHNUNG EBENER UND RAEUMLICHER STABWERKE MIT DEM KRAFT- UND FORMAENDERUNGS GROESSENVERFAHREN NACH EINER ALLGEMEINEN THEORIE KLEINER VERFORMUNGEN IN MATRIZENSCHREIBWEISE. THEORETISCHE GRUNDLAGEN ZU PAS]**
K.-H. Moeller, H. Moerchen, and G. Voelkel 1970 67 p refs In GERMAN *Its* Publ. No. 9 Sponsored by Deut. Forschungsgemeinschaft
Avail: NTIS

Algorithms were developed in matrix notation for the structural analysis of grids, planar and spatial frames by displacement and force methods. The second method in particular was formulated in a new way in order to obtain the band structure of the redundants in the coefficient matrix and to find a simple and fast means of computing the joint displacements. Nonlinear analysis is also described, including equilibrium considerations in the displaced system and flexural shortening of the structural members. For the displacement method the influence of joint displacements upon equilibrium was included directly in the coefficient matrix of redundant displacements. Only in the case of axial forces and nonlinear geometry was an iterative technique necessary. ESRO

N72-11807# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THE SOLUTION OF AXISYMMETRICAL AND CERTAIN OTHER SPACE PROBLEMS IN THE THEORY OF ELASTICITY BY MEANS OF ANALYTICAL FUNCTIONS**
A. Ya. Aleksandrov 19 Apr. 1971 35 p refs Transl. into ENGLISH from Appl. of the Theory of Functions in Continuum Mech. (Moscow), v. 1, 1965 p 97-118
(AF Proj. 683M)
(AD-727463; FTD-MT-24-15-71) Avail: NTIS CSCL 20/11

The theory of functions of a complex variable is applied to the solution of problems in the theory of elasticity involving surfaces symmetrical about the axis on the basis of the relation of the axisymmetrical state with the state of a plane surface. The relations between axisymmetrical and plane states are shown and the components for the former are described in functions of a complex variable. A solution for the boundary value problem is given using Cauchy integrals. The results, applying to an isotropic body, are extended to a transverse-isotopic body. Several problems in which the symmetry about the axis does not hold are considered along with their related boundary value problems. Author (GRA)

N72-11808# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.
**A THEORY OF VISCOPLASTICITY WITHOUT A YIELD SURFACE. PART 1: GENERAL THEORY**
K. C. Valanis Feb. 1971 32 p refs
(Grant AF-AFOSR-1916-70; AF Proj. 9749)
(AD-725030; AFOSR-71-1765TR-Pt-1) Avail: NTIS CSCL 20/12

A mathematical theory is proposed of thermo-viscoplasticity which is a synthesis of experimentally observed material behavior on one hand, and the concepts of irreversible thermodynamics on the other. The underlying principle is that the history of deformation is defined in terms of a 'time scale' which is not measured by a clock, but is in itself a property of the material at hand. The theory is unifying in the sense that theories of plasticity, viscoelasticity and elasticity can be obtained from it as special cases by imposing suitable constraints on the material parameters involved; furthermore, it does not make use of the idea of a yield surface. Author (GRA)

N72-11809# Wisconsin Univ., Madison. Mathematics Research Center.
**ON THE DESCRIPTION OF RHEOLOGICAL PROPERTIES OF VISCOELASTIC CONTINUA. 1: BODY-, SPACE-, AND CARTESIAN-SPACE-TENSOR FIELDS** Technical Summary Report
A. S. Lodge Mar. 1971 43 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-725084; MRC-TSR-1092) Avail: NTIS CSCL 20/11

An explicit definition of tensor fields leads to a comparison of alternative descriptions of stress and strain by means of (1) body fields, (2) convected components, and (3) Cartesian tensors. Author (GRA)

N72-11810# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
**PROPAGATION OF HARMONIC WAVES IN ORTHOTROPIC CIRCULAR CYLINDRICAL SHELLS. PART 2: NUMERICAL ANALYSIS**
Anthony E. Armenakas and Edward S. Reitz Apr. 1971 38 p refs
(Contract N00014-67-A-0438-0006; NR Proj. 064-427)
(AD-725115; PIBAL-71-10-Pt-2) Avail: NTIS CSCL 20/11

The frequency equation for harmonic waves with an arbitrary number of circumferential modes traveling in traction-free

circular cylindrical shells made of orthotropic material, established in the first part of this investigation has been programmed for numerical evaluation on an IBM 360/50 digital computer system. The numerical results are compared with those obtained on the basis of a shell theory. Author (GRA)

N72-11811# Chesapeake Coll., Wye Mills, Md.
**PROCEEDINGS OF THE 15TH MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP**
W. T. Sawyer 1 Jun. 1971 54 p refs Meeting held at Dayton, Ohio, 14-15 Apr. 1971
(Contract N00014-69-C-0108; NR Proj. 249-015)
(AD-725200; MFPG-8) Avail: NTIS CSCL 20/11

The document is a report of two-day discussions by a group of nationally-recognized specialists of the subject 'Corrosion Effects in Mechanical Failure'. Summaries are presented of sixteen prepared talks which had as their objective the examination of the state of the art in the study of the many mechanisms of corrosion which have been observed to lead to ultimate mechanical failure. Limitations and gaps on the technology available for problem solving are identified, providing guidance for future research. Reports of problems encountered in current field service provide an estimate of the magnitude of the problem and the relevance of current research. Significant audience discussions are reported. Author (GRA)

N72-11812# Alabama Univ. Research Inst., Huntsville. Div. of Graduate Programs and Research.
**ANALYSIS OF NONLINEAR, DYNAMIC COUPLED THERMOVISCOELASTICITY PROBLEMS BY THE FINITE ELEMENT METHOD**
J. T. Oden and W. H. Armstrong Jun. 1971 40 p refs
(Contract F44620-69-C-0124; AF-7921 Proj.)
(AD-725704; UARI-RR-104; AFOSR-71-1078TR) Avail: NTIS CSCL 20/11

The investigation deals with the numerical solution of a class of nonlinear problems in transient, coupled, thermoviscoelasticity. Equations of motion and heat conduction are derived for finite elements of thermomechanically simple materials and these are adapted to special classes of thermorheologically simple materials. The analysis involves the solution of large systems of nonlinear integrodifferential equations in the nodal displacements and temperatures and their histories. As a representative example, the general equations are applied to the problem of transient response of a thick-walled hollow cylinder subjected to time-varying internal and external pressures, temperatures, and heat fluxes. The integration scheme used to solve the nonlinear equations employs a linear acceleration assumption, representation of nonlinear integral terms by Simpson's rule, and the iterative solution of large systems of nonlinear algebraic equations at each reduced time step by the Newton-Raphson method. Various numerical results are given and are compared with the linearized, isothermal, and quasi-static solutions. Author (GRA)

N72-11813# Bell Aerospace Co., Buffalo, N.Y.
**OPTIMAL STRUCTURAL DESIGN Final Report, Oct. 1969 - Oct. 1970**
Ronald A. Gellatly and Laszlo Berke Apr. 1971 74 p refs
(Contract F33615-70-C-1065; AF Proj. 1467)
(AD-725745; BA-2442-933001; AFFDL-TR-70-165; Task-146705) Avail: NTIS CSCL 13/13

The report considers the state of the art in methods of structural optimization. Mathematical programming based methods, while extremely successful with problems of moderate size tend to become prohibitively costly when applied to large scale structures. A novel approach to the weight optimization of indeterminate structures under multiple loading conditions with strength and displacement constraints has been developed and is presented herein. Using this method significant improvements in computational time have been achieved over direct numerical search methods. In some cases the numbers of iterations required to determine the least weight have been reduced by factors of over 20. The rate of convergence is independent of problem size permitting application to large scale structures. Examples of application of the new approach to a number of problems are included. Author (GRA)

N72-11814# Watervliet Arsenal, N.Y.
**VIBRATIONS OF ISOTROPIC PLATES UNDER VARIOUS BOUNDRY CONDITIONS**
John D. Vasilakis and Thomas E. Simkins Mar. 1971 27 p refs
(DA Proj. 1-F-061102-A-33-F)
(AD-725481; WVT-7115) Avail: NTIS CSCL 20/11

The natural frequencies of rectangular isotropic plates under various boundary conditions including clamped, free and simply supported edges were found experimentally. Excitation was provided by an electronic shaker table. The results are tabulated and sand patterns showing the nodal lines are presented. This work was performed to provide experimental results for the chordwise bending theory. Results compare well with experiment. Author (GRA)

N72-11815# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
**AN ENERGY APPROACH TO THE DYNAMIC BUCKLING OF SPHERICAL CAPS Interim Report**
Ting-Lung Liu and Charles D. Babcock, Jr. Apr. 1971 34 p refs
(Grant AF-AFOSR-1424-68; AF Proj. 9782)
(AD-725703; CALCIT-SM-71-2; AFOSR-71-1076TR) Avail: NTIS CSCL 20/11

An experimental study to determine the dynamic buckling load of a spherical cap under impulsive loading was carried out. Impulsive loading was realized experimentally by use of a spray deposited explosive (Silver Acetylide-Silver Nitrate). The experimental dynamic buckling loads were compared to the dynamic buckling loads as calculated by using an energy criterion. The critical load from the energy criterion was determined by the conducting static pressure volume tests on the spherical caps. It was found that experimental results were consistently below the dynamic buckling load as predicted by the energy criterion. It was thought that this inconsistency resulted from the fact that transition state found in the static experiment was not the same as the dynamic transition state. Author (GRA)

N72-11816# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.
**NONLINEAR VIBRATION OF THIN PLATES Ph.D. Thesis**
Chin-Po Kuo May 1971 106 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-725486; THEMIS-UI-31) Avail: NTIS CSCL 01/3

Nonlinear analysis of the vibration of thin plates considering in-plane motion, is investigated. The coupled nonlinear differential equations are fully hyperbolic if strains are tensile. The one dimensional case is investigated by exact and approximate methods. All approximate results are consistent in period, which is a function of amplitude. GRA

N72-11817# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
**AN INVESTIGATION OF THE OUT-OF PLANE DEFLECTION BEHAVIOR OF THIN SHEETS WITH CUT-OUTS IN A TENSILE FIELD**
George F. Zielsdorff Jun. 1971 270 p refs
(Contract DAHC04-68-C-0004)
(AD-725601; AROD-T-2-20-E) Avail: NTIS CSCL 01/3

The problem of a tensioned thin plate containing a centrally located hole is considered. The Karman plate formulation for moderately large deflection is extended to include multiply connected plates by deriving the set of auxiliary conditions which must be satisfied by a solution on each internal boundary. The coupled, nonlinear Karman equations may be linearized and uncoupled under specified conditions and then the equations describe a plane stress elasticity problem and a buckling problem

with a nonuniform prebuckle stress state. The stress distribution for a tensioned infinite sheet with a slot hole is determined by a complex variable analysis. Results of a photoelastic stress analysis for finite width plates are also presented and compared with the complex variable solution for the same hole geometries. By an examination of the stability problem, it is shown that a Southwell form load-displacement relation can be derived. The limit of applicability of the Southwell technique is found to depend on the extent to which stiffening due to middle surface stretching influences the load-deflection response. A method of experimentally detecting this effect is described and used as a basis for an experimental study of the local buckling behavior of tensioned sheets with slots. The buckling data obtained are analyzed and a relation for the tensile buckling stress as a function of slot geometry is developed. Author (GRA)

N72-11818# Case Western Reserve Univ., Cleveland, Ohio. Div. of Solid Mechanics Structures and Mechanical Design.
**DEVELOPMENTS IN STRUCTURAL ANALYSIS AND SYNTHESIS BY FUNCTION MINIMIZATION** Final Report, 1 Nov. 1968 - 1 Sep. 1970
Lucien A. Schmit, Jr., Warren Gibson, Gary Vanderplaats, and Donald Shelangoskie Wright-Patterson AFB, Ohio AFFDL Apr. 1971 150 p refs
(Contract F33615-69-C-1209; AF Proj. 1467)
(AD-725570; AFFDL-TR-70-175) Avail: NTIS CSCL 13/13

Function minimization methods in structural analysis and optimum design are discussed. A computer program which implements the energy search method of nonlinear finite element analysis is presented. Several recent weight optimization methods based on finite element analysis are reviewed. Special characteristics of the finite element method relevant to automated design are identified. Some efficient approximate analysis methods for optimization applications are explored. Applications of some of these methods to plane frames and finite-deflection trusses are presented. Author (GRA)

N72-11819# Virginia Polytechnic Inst., Blacksburg.
**THE DUGDALE MODEL APPLIED TO THE TRANSVERSE BENDING OF PLATES**
Henry Gonzalez, Jr. and H. F. Brinson Jun. 1971 25 p refs
(Contract DAAF07-70-C-0444)
(AD-725598; VPI-E-71-11) Avail: NTIS CSCL 20/11

The Dugdale mathematical model is developed for the cylindrical bending of thin plates. The resulting finiteness condition, orplastic zone size, is found to be a function of the applied moment and the normal coordinate of the plate. The results of cylindrical bending tests of polycarbonate are presented where plastic zone size measurements are compared to the derived theoretical model. Good agreement is found although large deformations were encountered. The reasons for the validity of the theory as well as the good correlation between theory and experiment are discussed. Finally, compression plastic zones are presented and their relation to crack closure discussed.
Author (GRA)

N72-11820# Grumman Aerospace Corp., Bethpage, N.Y.
**AN AUTOMATED PROCEDURE FOR THE OPTIMIZATION OF PRACTICAL AEROSPACE STRUCTURES. VOLUME 1: THEORETICAL DEVELOPMENT AND USER'S INFORMATION** Final Report, 15 Jan. 1969 - 15 Aug. 1970
Walter J. Dwyer, Robert K. Emerton, and Irving U. Ojalvo Wright-Patterson AFB, Ohio AFFDL Apr. 1971 208 p refs
(Contract F33615-69-C-1278; AF Proj. 5710)
(AD-726112; ADR-02-01-71-Vol-1; AFFDL-TR-70-118-Vol-1) Avail: NTIS CSCL 01/3

The report documents the development of a new structural optimization algorithm, which is a combination of a modified fully stressed design technique and a redesign procedure based on gradients to deflection constraint surfaces. The algorithm is incorporated into a large finite element program based on the displacement method of structural analysis. Using an IBM 360/75 computer, the program is capable of obtaining near optimum distributions of material for structural idealizations consisting of up to three thousand elements and six thousand degrees of freedom, and subjected to a maximum of twenty loading conditions. Constraints may be placed on the maximum and minimum size of any of the elements, on the stresses in the elements, and on the displacements of the nodal points of the structure. Several examples of structures that were optimized are included to demonstrate the various features of the program, and to compare results with previously obtained solutions. To help make the program useful in the design of major aircraft structures, care has been taken to simplify the input and to present the program output in a form that is meaningful to the aircraft stress engineer. Results of an exploratory investigation into the optimization of dynamically loaded structures are presented, and the conversion of two existing blast-response shell codes into a unified synthesis program is documented.
Author (GRA)

# 33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics, and 27 Propellants.

N72-11821 National Lending Library for Science and Technology, Boston Spa (England).
**AN AUTONOMOUS HEAT CONDUCTOR [AVTONONNYI TEPLOPROVOD]**
A. Kh. Cherkasskii Aug. 1971 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Energ. Transp. (USSR), no. 3, 1969 p 95-103
(NLL-RTS-6451) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.70; 6 NLL photocopy coupons

The possibility is considered of developing a local autonomous heat conductor for intensive heat transfer from a heat source to a heat receiver when the two are far apart. The heat conductor consists of two thermal resistances connected in series between the heat source and the sink. The conductor is a long hollow rod filled with electricity conducting heat-transfer medium and a short thermal resistance which generates electricity. The thermoelectric currents that are generated flow through the heat conductor and interactions between them or between them and an external magnetic field cause directional circulation of the heat-transfer medium in the closed cavity of the heat conductor. It is shown that if the permissible temperature difference between the heat source and the heat receiver, referred to as the square root of the relative length of the heat conductor, is greater than one degree the rate of heat-transfer through the autonomous heat conductor is higher then if obtained by conduction through copper or other rods. Author

N72-11822 National Lending Library for Science and Technology, Boston Spa (England).
**HEAT EXCHANGE CHARACTERISTICS OF LIQUID METAL COOLANTS CONTAINING IMPURITIES**
V. I. Subbotin et al 28 Jul. 1971 37 p refs Transl. into ENGLISH from the book "Physico-Chemical Fundamentals of the Use of Liquid Metal Coolants" Atomizdat, 1970 p 254-275
(NLL-Risley-Tr-2170-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The effect of impurities on the operation of heat exchangers using liquid coolants is discussed. The presence of gaseous impurities in liquid metals reduces heat transfer through accumulation of deposits on heat exchanger surfaces. The conditions of impurity accumulation vary on cold and hot surfaces and the effect on the heat exchange is different for the cases of heating and cooling. Methods and formulas for calculating the heat exchange of pure liquid metal coolants are presented. Author

N72-11823 National Lending Library for Science and Technology, Boston Spa (England).
**A FIRST STUDY OF A HEAT EXCHANGER IN He AT ELEVATED PRESSURES, AT JUELICH NUCLEAR RESEARCH INSTITUTE**
H. G. Groehn, F. Scholz, and G. Tuerk 22 Sep. 1971 6 p refs Transl. into ENGLISH from Atomwirtschaft-atomtechnik (Dusseldorf), v. 15, Dec., 1970 p 576-577
(NLL-CE-Trans-5719-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A study of heat exchangers and other components of high temperature reactors in a large test rig in helium at pressures of up to 40 bars and temperatures of up to 400 C was conducted. Results are given of two series of tests with air and helium respectively. Agreement between the air and helium data was excellent, which showed that the similarity theory of heat transfer is entirely suitable for applying, to helium operation, the data obtained with air, in spite of major differences in some material charecteristics. Author

N72-11824 Purdue Univ., Lafayette, Ind.
**THE EFFECT OF FUEL COMPOSITION ON EXHAUST EMISSIONS FROM A SPARK-IGNITION ENGINE Ph.D. Thesis**
Ralph David Fleming 1970 131 p
Avail: Univ. Microfilms Order No. 70-18639

A single cylinder research engine was used to investigate the effects of fuel composition on exhaust emission. Used as fuels were three pure hydrocarbons representing the primary hydrocarbon types present in commercial motor fuels: (1) a paraffin (2,2,4-trimethylpentane), (2) an olefin (2,4,4-trimethylpentene-2), and (3) an aromatic (meta xylene). Exhaust gas samples were collected and quantitatively analyzed for carbon monoxide, carbon dioxide, hydrogen, nitrogen oxides, aldehydes, and hydrocarbons. Exhaust hydrocarbons were separated and quantitatively measured with a chromatographic system. The results of the exhaust gas analyses showed that: ethylbenzene, 1-methyl-3-ethylbenzene, and 1-methyl-3-vinylbenzene were more abundant in the exhausts from either 2,2,4-trimethylpentane-m-xylene, or 2,4,4-trimethylpentene-2-m--xylene fuel mixtures than in exhaust produced from m-xylene. It was also found that the pure 2,4,4-trimethylpentene-2 fuel produced smaller amounts of C sub 2 to C sub 7 olefins in the exhaust than that produced by the pure 2,2,4-trimethylpentane fuel. Dissert. Abstr.

N72-11825 Purdue Univ., Lafayette, Ind.
**BURNING-RATE TEMPERATURE SENSITIVITY OF COMPOSITE SOLID PROPELLANTS Ph.D. Thesis**
David Leland Ewing 1970 161 p
Avail: Univ. Microfilms Order No. 70-18637

The results of analyses and experiments conducted to determine which parameters are most influential in affecting the composite solid propellant burning rate temperature sensitivity are presented. Several combustion models for composite solid propellants were reviewed. Summerfield's granular diffusion flame model was found to be the best representation of the combustion processes from the engineering design standpoint. The compact burning rate equation resulting from the model was analyzed and an explicit expression for burning rate in terms of initial propellant temperature was obtained. This expression reveals that the propellant burning surface temperature and the surface heat release are important in affecting the sensitivity of burning rate to initial propellant temperature. Strands of several propellant formulations were burned in a modified Crawford type strand burner. The burning rate was measured as a function of pressure and initial temperature. The results indicate that the temperature effects parameter is important in influencing the burning rate and the burning rate temperature sensitivity of composite solid propellants. Dissert. Abstr.

N72-11826 California Univ., Berkeley.
**EVAPORATION FROM THIN LIQUID FILMS Ph.D. Thesis**
Kang Ryul Chun 1969 163 p
Avail: Univ. Microfilms Order No. 70-17530

The problem of the evaporation from the surface of a liquid layer running down a vertical wall was considered with particular reference to film type evaporators and the prediction of the performance of such units. The flow in such a liquid layer may be either laminar or turbulent and particularly for the latter regime the available measurements for the transfer coefficient remain uncertain, so that additional results were obtained for the evaporation of water for saturation temperatures between 83 and 212 F. In the laminar region the coefficients determined agreed with those for the wavy laminar region as usually obtained in condensation experiments. Such agreement terminated in a region where the Weber number of the film was of the order of unity and for higher Prandtl numbers this occurred at Reynolds numbers well below the usual transition value. The heat transfer coefficients cease to exist when the fluid near the wall is superheated sufficiently for boiling to begin. Nucleate boiling was observed in some of the experiments. It is shown that the points where initiation occurred imply cavity sizes which might be expected. Dissert. Abstr.

N72-11827 Stanford Univ., Calif.
**A STUDY OF TWO PROBLEMS IN THERMAL CONVECTIONS. 1: FINITE AMPLITUDE CONVECTION IN CYLINDRICAL GEOMETRIES. 2: BUOYANCY DRIVEN CONVECTION IN A NON-NEWTONIAN FLUID LAYER Ph.D. Thesis**
Shen Fu Liang 1970 198 p
Avail: Univ. Microfilms Order No. 70-18433

An extensive numerical analysis of buoyancy-driven convection in a cylindrical cell has been made. Steady state solutions to the Boussinesq equations containing a temperature-dependent viscosity were obtained for numerous different boundary conditions. In agreement with previous experimental observations, two axisymmetric solutions, one with upflow and the other with downflow at the center of the cell, were found for each case considered. An extension to include the case of surface-tension-driven convection was also made and again, two solutions were obtained. Dissert. Abstr.

N72-11828*# North Carolina State Univ., Raleigh. Mechanical and Aerospace Engineering Dept.
**CALCULATION OF INVISCID SURFACE STREAMLINES AND HEAT TRANSFER ON SHUTTLE TYPE CONFIGURATIONS. PART 2: DESCRIPTION OF COMPUTER PROGRAM**
Fred R. DeJarnette and Michael H. Jones Aug. 1971 255 p
(Contract NAS1-10277)
(NASA-CR-111922) Avail: NTIS CSCL 20M

A description of the computer program used for heating rate calculation for blunt bodies in hypersonic flow is given. The main program and each subprogram are described by defining the pertinent symbols involved and presenting a detailed flow diagram and complete computer program listing. Input and output parameters are discussed in detail. Listings are given for the computation of heating rates on (1) a blunted 15 deg half-angle cone at 20 deg incidence and Mach 10.6, (2) a blunted 70 deg slab delta wing at 10 deg incidence and Mach 8, and (3) the HL-10 lifting body at 20 deg incidence and Mach 10. In addition, the computer program output for two streamlines on the blunted 15 deg half-angle cone is listed. For Part 1, see N71-36186. Author

N72-11829*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**TRANSIENT-FORCED CONVECTION FILM BOILING ON AN ISOTHERMAL FLAT PLATE**
H. R. Nagendra Washington Nov. 1971 42 p refs
(NASA-TN-D-6554; M-370) Avail: NTIS CSCL 20M

An approach for the solution of transient-forced convection

film boiling on an isothermal flat plate using the boundary layer model is developed. The similarity variables are used to convert the governing partial differential equations to ordinary ones. The results of numerical solutions of these ordinary equations indicate that the transient process can be classified as one-dimensional conduction, intermediate, and the steady state regions. The time required for the one-dimensional conduction and the time necessary to attain a steady state condition are obtained. The influence of interfacial shear is seen to be negligible while the Prandtl Number and the ratio (C sub p delta T divided by h sub fg times Pr) have major influence. The use of local similarity approximations for the intermediate regime facilitates prediction of complete boundary layer growth. Using the ratio of time at any instant to the steady state time as abscissa, the curves representing the boundary layer growth can be merged into a single mean curve within 5 percent. Further, the analysis shows that the average rate of heat transfer during transient is 50 to 100 percent higher than those at steady state. The average rate of vapor convected away is 10 to 15 percent lower than at steady state while the average rate of accumulation to form the vapor layer is 1 to 14 times larger. Further, the total heat transferred during transient increases and the evaporation decreases for increasing values of C sub p delta T divided by h sub fg times Pr. Author

**N72-11830*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**DUAL MEASUREMENT ABLATION SENSOR Patent Application**
Charles A. Gurtler, inventor (to NASA) Filed 11 Aug. 1971 8 p
(NASA-Case-LAR-10105-1; US-Patent-Appl-SN-170680) Avail: NTIS CSCL 20M

A dual measurement ablation sensor for measuring both char-interface and surface recession at a point in an ablating material to allow an accurate calculation of the thickness of the char layer. Char-interface recession is indicated by a drop in the resistance to a current passed through the ablation material. Surface recession is indicated by the closing of an electrical circuit when melting causes the release of a spring switch. NASA

**N72-11831#** Naval Weapons Center, China Lake, Calif.
**HEAT TRANSFER IN SOLID PROPELLANT MOTORS**
Anthony SanMiguel and Robert M. McCarten May 1971 24 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Spacecraft and Rockets in Mar. 1972
Avail: NTIS

A temperature cycle experiment was performed with an analog thin-walled case bonded solid propellant motor instrumented with embedded miniature thermocouples. It is shown that a significant discrepancy exists between theory and experiment, even when inside-the-case transient experimental temperature data is used as a boundary condition together with measured temperature sensitive thermal properties. The common practice of solely using the temperature data from the outer surface of a rocket motor to define the boundary conditions was found to be inadequate for predicting transient temperatures in the grain. Also, the Fourier heat conduction equation is inadequate for solid propellant, because, the thermal constitutive equations, used to synthesize this conservation of thermal energy equation, are poor approximations for solid propellant. Author

**N72-11832#** Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering.
**APPLICATION OF ADIABATIC CALORIMETRY TO METAL SYSTEMS Progress Report, 1970 - 1971**
E. E. Stansbury and C. R. Brooks [1971] 14 p refs
(Contract AT(40-1)-3291)
(ORO-3291-15) Avail: NTIS

The research on the application of adiabatic calorimetry to metal systems is reported with emphasis on the conversion of calorimeter data acquisition methods and control techniques to programmed operations by digital computer. Papers published during this period are listed. F.O.S.

**N72-11833#** Northwestern Univ., Evanston, Ill. Dept. of Chemistry and Materials Research Center.
**LIMITATIONS IN APPLYING MASS SPECTROMETRY TO HIGH-TEMPERATURE EQUILIBRIUM STUDIES**
Fred E. Stafford [1971] 27 p refs Sponsored by AEC
(COO-1147-35) Avail: NTIS

The application of mass spectrometry to the identification of gases and determination of thermodynamic properties of gases and condensed phases in high temperature systems is considered. Techniques considered include molecular beam chopper/phase sensitive detector systems, high pressure sampling systems, on-line computers, and use of internal pressure standards. Sources of systematic error include lack of equilibration in the sample cell, condensation in noneffusive molecular beams, the ionization process, and discrimination by the secondary electron multiplier. Of these, ionization and fragmentation seem to be the least susceptible of internal checks. Author

**N72-11834#** Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
**HEAT EXCHANGER OPTIMIZATION CODE**
J. E. Mott 12 Jul. 1971 54 p
(Contract W-7405-eng-26)
(K-1799) Avail: NTIS

A Fortran 4 program was developed to furnish an optimum design for a cross-flow gas cooler. It permits either single-phase or two-phase flow in any coolant passage and will accommodate multiple-pass configurations. The output of the program gives detailed physical parameters as well as cost information. A description of the heat transfer analysis, cost optimization, and design procedure, along with an example of the program's use, is presented. Author

**N72-11835#** Bureau of Mines, Washington, D.C.
**REDUCTION OF AIR POLLUTANTS FROM GAS BURNER FLAMES: INCLUDING RELATED REACTION KINETICS**
Margaret E. Harris, Valeria R. Rowe, E. B. Cook, and J. Grumer 1970 74 p refs
(PB-198109; BM-Bull-653) Avail: NTIS; SOD $0.70 CSCL 21B

The formation of nitrogen oxides, the decay of carbon monoxide, and the concentrations of residual hydrocarbons in the secondary combustion zones of propane-air and methane-air flames were studied in three enclosed burners designed to simulate gas appliances such as space and water heater. The effect of thermally or chemically perturbing combustion gases above these flames was determined theoretically and by means of factorial experiments. Flame temperatures and the concentrations of air pollutants were measured, and the effects of secondary air ingress to the primary and secondary combustion zones, flame stability, burner port surface, and simulated recycling of combustion gases were noted. Empirical reaction rates were derived that predict the concentrations of nitrogen oxides and carbon monoxide in the primary and secondary combustion zones. Author (GRA)

**N72-11836#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**SHOCK INITIATED IGNITION OF ETHANE-OXYGEN-ARGON MIXTURES Final Report**
Alexander Burcat, Karl Scheller, Robert W. Crossley, and Gordon B. Skinner Feb. 1971 29 p refs
(AF-7023 Proj.)
(AD-725784; ARL-71-0032) Avail: NTIS CSCL 21/2

A detailed study was made of ignition delay times in ethane-oxygen-argon mixtures behind a reflected shock wave as indicated by pressure and light emission observation. Measured induction times ranged from 20-600 microsec over a temperature interval of 1235 - 1660K and associated pressures of from 2-8

atm. To elucidate composition effects, the equivalence ratio of the test mixture were varied from 0.5 - 2.0 in approximately 95% dilution with argon. Author (GRA)

N72-11837# Picatinny Arsenal, Dover, N.J.
**CHEMICAL ASPECTS OF THE SHOCK INITIATION OF FUEL DROPLETS**
Pai Lien Lu and Norman Slagg May 1971 36 p refs
(AD-725994; PA-TR-4153) Avail: NTIS CSCL 21/2

A study was conducted of the shock initiation of droplets of five fuels in an oxygen atmosphere. The fuels were ethyl nitrate, propyl nitrate, nitromethane, butyl alcohol, and nitrobenzene. Only the two nitrates ignited. They also were observed to ignite in shocked argon. Their behavior is explained on the basis of their weak bonds and their ability to behave as monopropellants. Schlieren photographs showed that autoignition occurred in the wake of the droplet, and that the flame front expanded rapidly and induced a strong blast wave. The trajectories of the flame fronts and blast waves of the burning nitrate droplets were plotted, and empirical expressions were found. Author (GRA)

N72-11838# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
**UNSTEADY COMBUSTION IN GASEOUS PROPELLANT ROCKET MOTORS**
Donald R. Hardesty Dec. 1970 403 p refs
(Grant AF-AFOSR-1649-69; AF Proj. 9711)
(AD-726118; AMS-T-965; AFOSR-TR-71-0922) Avail: NTIS CSCL 21/2

This research work was directed toward the development of a consistent experimental and theoretical description of the phenomenon of intrinsic unstable combustion in the gas rocket. A determination was achieved of the contribution of gas phase rate processes, (in particular, chemical kinetics), to the coupling of a finite-dimensional unsteady turbulent combustion zone and finite amplitude (linear and nonlinear) longitudinal mode pressure oscillations. Author (GRA)

N72-11839# California Univ., La Jolla.
**THE 7TH AFOSR COMBINED CONTRACTORS' MEETING ON COMBUSTION DYNAMICS RESEARCH**
R. D. Sutton and S. S. Penner 7 Jun. 1971 75 p Meeting held at La Jolla, Calif., 7-11 Jun. 1971
(Contract F44620-68-C-0010; AF Proj. 7921-02)
(AD-726121; AFOSR-71-0532TR) Avail: NTIS CSCL 21B

The report consists of a collection of abstracts of research progress reports. Each paper was grouped under one of the three major subject headings: Advanced Air Breathing Combustion; Liquid Propellant Rocket Combustion; or Solid Propellant Rocket Combustion. The principal investigators and their organizational association are also identified. Author (GRA)

N72-11672# Shell Development Co., Emeryville, Calif.
**COOLING OF ADVANCED ENGINES BY ENDOTHERMIC REACTIONS OF HYDROCARBON FUELS**
L. E. Faith, G. H. Ackerman, and H. T. Henderson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs Sponsored by AFAPL (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11680# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**FLAME INHIBITION CHEMISTRY**
R. M. Fristrom and R. F. Sawyer *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety refs (See N72-11668 02-27)
(Grant NSF GI-12)
Avail: NTIS HC $6.00/MF $0.95

N72-11681# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
**FLAMMABILITY PROPERTIES OF JET FUELS AND TECHNIQUES FOR FIRE AND EXPLOSION SUPPRESSION**
B. P. Botteri *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11682# Institut Francais du Petrole, Paris (France).
**INFLUENCE OF MOLECULAR STRUCTURE ON SELF-IGNITION PROPERTIES OF HYDROCARBONS [INFLUENCE DE LA STRUCTURE MOLECULAIRE SUR CERTAINES PROPRIETES D'AUTO-INFLAMMATION DES HYDROCARBURES]**
G. DeSoete *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11683# Princeton Univ., N.J. Guggenheim Lab.
**IGNITION OF FUELS BY A HOT PROJECTILE**
O. P. Sharma and W. A. Sirignano *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 16 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11684# Centre National de la Recherche Scientifique, Paris (France).
**INFLUENCE OF PROMOTERS (FREE RADICALS) AND INHIBITORS ON DIFFUSION FLAMES [INFLUENCE DES PROMOTEURS (RADICAUX LIBRES) ET DES INHIBITEURS SUR LES FLAMMES DE DIFFUSION]**
J. Combourieu, C. Falinower, and G. Denis *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs In FRENCH; ENGLISH summary (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11686# Shell Research, Ltd., Chester (England).
**ELECTROSTATIC CHARGING IN THE HANDLING OF AVIATION FUELS**
H. Strawson and A. Lewis *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11690# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
**FIRE AND EXPLOSION PROTECTION OF FUEL TANK ULLAGE**
J. A. MacDonald and H. W. G. Wyeth *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 7 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11692# Royal Aircraft Establishment, Farnborough (England). Materials Dept.
**SIMULATED CRASH TESTS AS A MEANS OF RATING AIRCRAFT SAFETY FUELS**
R. E. Miller and S. P. Wilford *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

N72-11693# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**SURFACE ACTIVE CONSIDERATIONS IN FUEL FIRES**
Richard L. Tuve *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 4 p refs (See N72-11668 02-27)
Avail: NTIS HC $6.00/MF $0.95

# 34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N72-11840# Serendipity, Inc., Arlington, Va. Eastern Operations Div.
**A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 5: TRAIN SYSTEM NOISE Final Report**
Nov. 1970 116 p refs
(Contract DOT-OS-A9-018)
(OST-ONA-71-1-Vol-5) Avail: NTIS

The noise from an individual vehicle is a function of the physical characteristics of the vehicle, the way in which the vehicle is operated and the construction characteristics of the vehicle's guideway, e.g., rail condition, roadbed supporting structure. Noise reduction at the source can be obtained by altering the vehicle and/or the guideway and by changing the way the vehicle is operated. Analysis of contemporary mass transit vehicle noise indicates that the rank order of conventional rail vehicle noise sources is: (1) wheel and rail system, (2) propulsion system; and (3) auxiliary equipment. Noise levels alongside the right-of-way, are a function of the vehicle type, its operation and the configuration of the roadbed and surrounding areas. Rail vehicle wayside noise levels can be reduced by interrupting the sound transmission paths between the vehicle and the receiver. To the extent that this is achieved, rail vehicle wayside noise levels can be reduced in a manner which is similar to that used for highway noise reduction. Author

N72-11841# Serendipity, Inc., Arlington, Va. Eastern Operations Div.
**A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 6: COMMUNITY TRANSPORTATION NOISES Final Report**
Nov. 1970 204 p refs
(Contract DOT-OS-A9-018)
(OST-ONA-71-1-Vol-6) Avail: NTIS

A prototype model has been developed to estimate community noise levels resulting from the operation of all modes of transportation in a community. The model has been exercised for the Baltimore Metropolitan Area and two statistics were computed, the median noise level and the noise pollution level; both use the A-weighted sound level as a noise measure. The median level is that which is exceeded 50% of the time. The noise pollution level accounts for the median and the distribution of noise levels about it. Acceptable limits for the median level and the noise pollution level are applied to the levels estimated for the Baltimore Metropolitan Area and the implications are discussed in terms of land areas and population exposed to unacceptable noise levels. It is shown that the effect of transportation noise is widespread and the magnitude is such that comprehensive planning involving all of the extant and expected modes is required to effect any overall reductions to transportation generated noise levels. Author

N72-11842# National Materials Advisory Board, Washington, D.C.
**REPORT OF THE AD HOC COMMITTEE ON BERYLLIUM**
Oct. 1971 107 p refs
(Contract DA-49-083-OSA-3131)
(NMAB-281) Avail: NTIS

The role of the Department of Defense is examined in using beryllium and in advancing the technology. Improved system performance is attributable to beryllium's elastic, thermal, and nuclear properties, and its low density combined with adequate strength. The outstanding technical limitation for structural application is beryllium's low fracture toughness. Present applications, such as for guidance systems, brakes, and thrust chambers, would suffer significant performance penalties if beryllium were not available. Several design tradeoffs show beryllium to be competitive with, or superior to, filamentary composities, on a stiffness-to-weight basis, in advanced applications for lightweight structures. Increased usage of beryllium, however, will be unlikely without certain necessary development work which is described. In addition to beryllium's unique capabilities, a major justification for support of beryllium technology is its usefulness as an option in the event that competitive materials prove to be unsatisfactory in critical applications. Author

N72-11843# National Materials Advisory Board, Washington, D.C. Panel on Ferroalloys.
**A DELPHI EXPLORATION OF THE US FERROALLOY AND STEEL INDUSTRIES**
Jul. 1971 121 p refs
(Contract GS-OO-DS-(P)-94008)
(NMAB-277) Avail: NTIS

The implications of technological change on ferroalloy usage trends in the steel industry were assessed using the Delphi techniques, and by panel study. The results indicate the significant uncertainties in the following areas: scrap, pollution, geographical patterns, and foreign competition. Graphs of the trends, and general assumptions are included. F.O.S.

N72-11844*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**WHAT CAN NUCLEAR ENERGY DO FOR SOCIETY?**
Frank E. Rom Nov. 1971 24 p refs Presented at the 2nd Uranium Plasma Symp., Atlanta, 15-17 Nov. 1971; Sponsored by Am. Inst. of Aeron. and Astronautics
(NASA-TM-X-67963; E-6674) Avail: NTIS CSCL 05K

The utilization of nuclear energy and the predicted impact of future uses of nuclear energy are discussed. Areas of application in electric power production and transportation methods are described. It is concluded that the need for many forms of nuclear energy will become critical as the requirements for power to supply an increasing population are met. P.N.F.

N72-11845*# Boeing Co., Seattle, Wash.
**STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS, SAN FRANCISCO BAY AREA**
Sep. 1971 541 p refs
(Contract NAS2-5969)
(NASA-CR-114347) Avail: NTIS HC $6.00/MF $0.95 CSCL 05C

The nine-county San Francisco Bay area is examined in two time periods (1975-1980 and 1985-1990) as a scenario for analyzing the characteristics of an intraurban, commuter-oriented aircraft transportation system. Aircraft have dominated the long-haul passenger market for some time, but efforts to penetrate the very-short-haul intraurban market have met with only token success. Yet, the characteristics of an aircraft transportation system-speed and flexibility-are very much needed to solve the transportation ills of our major urban areas. This study attempts to determine if the aircraft can contribute toward solving the transportation problems of major metropolitan areas and be economically viable in such an environment. Author

N72-11846# Department of Forestry, Vancouver (British Columbia). Western Forest Products Lab.
**ANALYSIS OF INTERDEPENDENT DATA OF A TYPE COMMON IN FOREST PRODUCTS RESEARCH**
W. G. Warren Aug. 1971 19 p refs
(VP-X-85) Avail: NTIS

There are several assumptions underlying conventional analysis of variance (fixed effects model) - additivity, homogeneity, normality and independence. In some experimental work interdependence is an integral part of the design; for example,

where the responses are deformations on the same individuals after exposure to various conditions. Such experiments are common in forest-products research. A strategy for the test statistics is expressed as a function of the unknown correlation(s). The various facets of this approach are illustrated by two examples drawn from forest-products experience. Relevant general theory is presented. Author

N72-11847*# National Aeronautics and Space Administration, Washington, D.C.
**RESEARCH AND TECHNOLOGY OPERATING PLAN SUMMARY, FISCAL YEAR 1972 RESEARCH AND TECHNOLOGY PROGRAM**
[1971] 393 p
(NASA-TM-X-67393) Avail: NTIS HC $6.00/MF $0.95 CSCL 05B

The NASA Research and Technology program for FY 1972 is presented. It is a compilation of the summary portions of each of the RTOPs (Research and Technology Operating Plan) used for management review and control of research currently in progress throughout NASA. The RTOP Summary is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. Author

N72-11848# Oak Ridge National Lab., Tenn.
**THE ENVIRONMENT AND TECHNOLOGY ASSESSMENT Progress Report, Jun.-Dec. 1970**
Feb. 1971 251 p refs
(Contract W-7405-eng-26; NSF Order AAA-R-4-79)
(ORNL-NSF-EP-3) Avail: NTIS

A study of electrical energy consumption patterns, processes, and economics in highly developed countries is presented. The relationship between consumption of non-renewable resources and environmental degradation which occurs with an increase in energy consumption is discussed. Serious questions about the desirability as well as the practicality of continuing current patterns of energy consumption and growth are examined. Author

N72-11849# RAND Corp., Santa Monica, Calif.
**PROCEEDINGS OF A CONFERENCE ON REGIONAL TRANSPORTATION PLANNING**
Joseph S. Desalvo, ed. May 1971 526 p refs Conf. held at Santa Monica, Calif., 25-27 Jan. 1971
(Contract DOT-OS-00074)
(PB-200076; R-706-DOT; DOT-OS-00074) Avail: NTIS HC $6.00/MF $0.95 CSCL 13B

The conference explored the idea that some form of transportation planning entity should be created between two existing levels of planning-the national level and individual states or smaller jurisdictions. The issue was to consider the advantages and disadvantages, in economic and administrative terms, of conducting transportation planning on a regional basis. Author (GRA)

N72-11850# Center for Naval Analyses, Arlington, Va. Inst. of Naval Studies.
**THE VALUE OF TIME IN AIR TRAVEL: THEORY AND EVIDENCE**
Arthur S. DeVany Apr. 1971 45 p refs
(Contract N00014-68-A-0091)
(AD-725480; Contrib-162) Avail: NTIS CSCL 15/5

The roles of time and money cost in the demand for air travel are analyzed. The first step is to construct the theory of consumer demand under a time constraint and to deduce its theorems. Then these theorems are applied to air travel through use of a total price demand function. This analysis considers the effects of fare, trip time, airport delay, schedule frequency, trip distance, traveler's wage rates, and non-wage income on the demand for air travel. Many results concerning elasticities are obtained, including a necessary relationship between the time, price, and total price elasticities of demand. Tests of the theorems are performed, the various elasticities are estimates, and the relationship between the elasticities required by the theory is used to obtain an estimate of the value of time in air travel. Author (GRA)

N72-11851# Naval Ordnance Lab., White Oak, Md.
**INDEPENDENT RESEARCH, 1970 Research Report, 1 Jan. - 1 Jul. 1970**
D. F. Bleil 15 Apr. 1971 120 p refs
(MAT Proj. 03L-000/ZR011-01-01; NOL Proj. 502-00002)
(AD-725496; NOLR-1280) Avail: NTIS CSCL 05/2

Contents: Applied physics; Physics research; Chemistry research; Explosions research; Aerodynamics; Ballistics; Mathematics. Author (GRA)

N72-11021# Boeing Co., Morton, Pa.
**IMPROVING THE READABILITY OF MAINTENANCE MANUALS**
Walter Jablonski *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 34 p (See N72-11019 02-02)
Avail: NTIS HC $6.00/MF $0.95

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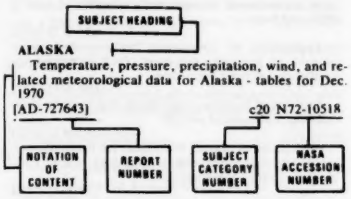


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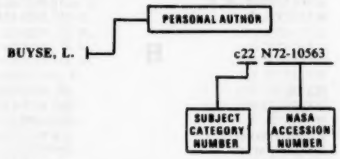


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BERTONE, C. M. c08 N72-11185
BERTRAND, J. C. c19 N72-11485
BERTSCH, D. L. c13 N72-11725
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BESSON, J. c14 N72-11367
BEST, D. L. c20 N72-11525
BETTERTON, J. O., JR. c26 N72-11656
BEUN, M. c08 N72-11193
BEZUS, E. V. c17 N72-11451
BIBILASHVILI, Y. K. c22 N72-11531
BIDLINGMEYER, B. A. c06 N72-11120
c14 N72-11378
BIGLER, S. G. c07 N72-11147
BIONDI, M. A. c13 N72-11328
BIRLEY, M. H. c13 N72-11326
BISHOP, H. P. c05 N72-11099
BLAIS, N. C. c24 N72-11629
BLAIVE, J. C. c30 N72-11781
BLAKELY, J. P. c22 N72-11550
BLALOCK, T. J. c11 N72-11156
BLAMONT, J. E. c30 N72-11774
BLAND, T. J. c15 N72-11406
BLASDELL, W. E. c08 N72-11201
BLAUER, J. A. c06 N72-11138
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BLOCKER, N. K. c29 N72-11731
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BOEHM, A. c23 N72-11552
BOGORODITSKII, N. P. c09 N72-11222
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BOLDT, G. c25 N72-11637
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BONDAVENKO, B. V. c09 N72-11223
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BORISEVICH, E. S. c13 N72-11356
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BOURRIEAU, J. c24 N72-11618
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BOWLEN, D. W. c17 N72-11436
BRACE, W. F. c13 N72-11347
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BRANDT, J. C. c30 N72-11750
c30 N72-11752
BRANER, A. A. c26 N72-11665
BRATOZ, S. c24 N72-11627
BREJCHA, A. G. c07 N72-11152
BREUGELMANS, F. A. E. c12 N72-11308
BREYNAT, G. c24 N72-11578
BRIDGEWATER, A. W. c08 N72-11181
BRILL, A. B. c05 N72-11089
BRINSON, H. F. c32 N72-11819
BROADHEAD, G. C. c13 N72-11319
BRODER, J. D. c03 N72-11064
BROKL, S. S. c08 N72-11208
BROOKS, C. R. c33 N72-11832
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BROWN, D. C. c21 N72-11528
BROWN, G. A. c09 N72-11231
BRUCE, R. A. c12 N72-11293
BRUST, R. c14 N72-11362
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BUDNIKOVA, N. A. c30 N72-11784
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BUNNER, A. N. c29 N72-11770
BURCAT, A. c33 N72-11836
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BURKE, J. P. c08 N72-11020
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CARLSON, G. A. c22 N72-11540
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CHIKULAYEV, M. S. c02 N72-11039
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FOLEY, D. H. c08 N72-11202
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FU, T. T. c12 N72-11279
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GARNER, H. C. c01 N72-11011
c01 N72-11012
GATHOF, A. c04 N72-11070
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GOLDBERG, S. J. c17 N72-11434
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GOLDSTEIN, R. M. c07 N72-11160
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GOUGH, J. W. c32 N72-11800
GOULD, R. W. F. c12 N72-11295
GOULDING, F. S. c24 N72-11617
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GRARD, R. J. L. c11 N72-11272
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GRECH, J. c08 N72-11179
GREEN, R. R. c07 N72-11160
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GREENE, N. M. c24 N72-11621
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HALE, G. J. c15 N72-11399
HALL, A. W. c02 N72-11038
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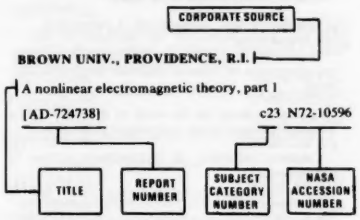


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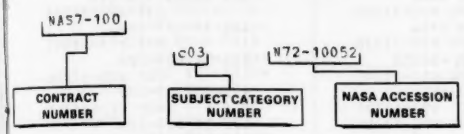


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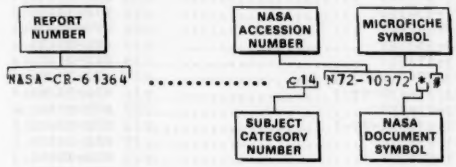


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A report consisting of 10 papers on the results of the observation of artificial clouds in the ionosphere and the exosphere. These clouds were produced by two sounding rockets carrying barium chemical release payloads launched in September 1966 from Wallops Island, Va., under a joint agreement between the National Aeronautics and Space Administration and der Bundeministerium für wissenschaftliche Forschung of West Germany. NASA's Langley Research Center represented NASA while the Institut für extraterrestrische Physik am Max-Planck-Institut für Physik und Astrophysik represented the West German Government. Intricacies of technical coordination have delayed publication of the report until now. *Paperbound.* 152 pp. For sale by the National Technical Information Service, Springfield, Va. 22151, for $3.00.

**Models of the Trapped Radiation Environment. Volume VII: Long Term Time Variations (NASA SP–3024)**

This volume contains four papers delivered during the International Association of Geomagnetism and Aeronomy General Scientific Assembly in Madrid in September 1969: The Low-Altitude Radiation Environment; Time History of the Inner Radiation Zone, October 1963 to December 1968; Long-Term Behavior of Energetic Inner-Belt Protons; The Particle Environment at the Synchronous Altitude. *Paperbound.* 80 pp. For sale by the National Technical Information Service, Springfield, Va. 22151, for $3.00.

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